# BULLETIN No. 23

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NOVEMBER, 1930

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POSSIBLY our members may feel that this bulletin is devoted almost exclusively to Canadian interests. Mr. Breithaupt has at no little care and research presented an interesting history of the growth and development of the Grand Trunk Railway. Mr. Loye's contribution on motive power supplements Mr. Breithaupt's contribution and the two articles give our members an interesting history of a road which many of us will welcome. Mr. Brown, also of Canada, has again given us an interesting contribution.

To supplement the Boston & Albany R. R. material that appeared in Bulletin No. 22, the performance of the early locomotives on the Boston & Worcester R. R. of nearly one hundred years ago, should be of interest to our members. To keep the article well within our limits, only the more interesting items have been given, but it affords us a word picture of the trials and tribulations, and there were many, of operating the first railroad opened for service in the state of Massachusetts. Appended to this article is a list of corrections covering errors in Mr. Becker's contribution in Bulletin No. 22. It was with regret that some of the information was discovered after the bulletin was distributed and others were of a typographical nature. With these corrections, the list of locomotives is as near correct as can probably be produced at this late day.

To those of our members who took the time and trouble to answer the questions that appeared on Page 62 of Bulletin No. 22, the officers of

this Society wish to express their sincere thanks. The replies received show that the writers are interested in what this Society is trying to accomplish and it is only from our members that we can learn if we are meeting your expectations. Many of the suggestions made should be of interest to our members and as rapidly as possible they will be carried out. One member, for example, has suggested that we give space in this bulletin as sort of a clearing house for books that he wishes to purchase or exchange. Although but two replies were received in connection with the notice that appeared in Bulletin No. 21, we will gladly list any of the wants of this nature that our members may desire and will you please forward them to the Editor.

One of our members whose duties call him to different parts of this country has been the means of arousing no little interest in the members of the same community. Very shortly our members will receive a list of our members who live in their section of the country and for those who desire a complete membership list as of March 31st of this year, may have one for the asking. Our member who has made these visits reports that many of our own members were surprised that there were so many others living in their vicinity. The Secretary of this Society or your own Representative will always gladly give you information in regard to our membership.

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The Society would like information and data relating to William H. Brown, author of "History of the First Locomotives in America." Mr. Brown drew many silhouettes of individuals and the Society would like information covering his work in this respect and if possible to obtain a picture of Mr. Brown himself.

Also, the Society would like to obtain a likeness of Mr. E. L. Miller, a man prominent in the venture of the South Carolina Canal and Railroad Company. If any of our members can give us any assistance in either of the above, it will be deeply appreciated.

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Mr. C. O. Becker, Fieldhead, Myddleton, Ilkley, England writes that he would like to procure copies of the Baldwin Quarterly Magazine for October 1922 and April 1924. He offers in exchange October 1925, January 1926, July 1926 and October 1926 numbers.

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At the meeting of the Directors of this Society held in the Baker Library on September 14th, it was voted to accept the resignation of Mr. C. L. Winey, as Director, due to his ill health.

The Directors confirmed the action of releasing Mr. E. A. Preston

as Executive Secretary, transferring the most necessary of his activities to other officers of the Society.

It was voted to continue the present membership dues for 1931. The Annual Membership fee will be $3.00 and will include the two bulletins containing miscellaneous material. The Contributing Membership fee will be $25.00 and include all bulletins issued during the current year. With the Life Membership fee of $100.00, it was voted to include all future bulletins upon payment of this fee. Those who are already Life Members will be included upon payment of the difference of the former Life Membership fee and the present life membership rate.

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In connection with some of the suggestions received from some of our members, an arrangement has been made with the Baker Library authorities whereby some of the books owned by the library will be available to our members. This will not include books in constant use. To list the books which might be of interest to our members would be impossible in our bulletin and it is suggested that our members who wish this service address their letters to Dr. Arthur H. Cole, Administrative Curator, Baker Library, Harvard Business School, Boston, Mass., stating the book or books they wish to borrow. Upon receipt of their letter, they will be advised if the book is available and arrangements will be made to forward you the book through your own local library who will notify you of its receipt. Members using this service are requested to return these books promptly to their own local library not keeping them over two weeks. The success of this plan will depend upon the use our members make of it and returning the books promptly and at the time stated.

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The Los Angeles Museum of History, Science and Art at Exposition Park, Los Angeles, California, is making a mechanical collection and is particularly anxious for material illustrating the history of transportation. They already have a number of good specimens from an oxcart up through the range of carriages, automobiles and aeroplanes, and they hope as soon as room becomes available to get a couple of early locomotives. Meanwhile they wish to make a collection of photographs or other historic material pertaining to railroads and locomotives.

One of the members of the Railway and Locomotive Historical Society has suggested that some of the members of the Society might like to contribute a few copies of some of their choice pictures of old engines or historic places connected with important events in railroading.

It is realized that some of the old-timers have very rare material that they are unwilling to have copied, as they like to feel that they have something unique, but this attitude often results in such material being eventually lost through fire or lack of appreciation of their heirs when

they pass on. Hence the reason for asking that copies of such pictures be preserved in such public collections as those of our Society or of the Los Angeles Museum.

If even a small portion of the membership of this Society would contribute a couple of prints each, a very comprehensive collection could soon be built up for the Museum that would be a credit to the Society. Several members have already cooperated very generously with the Museum, and their generosity has been greatly appreciated.

Any one wishing to send in pictures for preservation in this collection may address them to the Los Angeles Museum, Exposition Park, Los Angeles, California, c/o Ransom Mathews.

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On Sunday, December 7th at 3:00 P. M. we will have as guests, some of the Railroad Veterans of New England. Our members are urged to come and help welcome our guests and at the same time meet our own members and view the material that we have in the rooms. All who can do so are urged to come.

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## THE LIVERPOOL AND MANCHESTER CELEBRATION

So much has already been written about the history of the Liverpool & Manchester R. R. and its importance to the history and development of the steam locomotive and the railway that it need not be repeated here.

It may be of interest to our readers to learn that the celebration of the opening of this road was held in Liverpool from Sept. 13-20, 1930. It was sponsored by the London, Midland & Scottish Ry. and the cities of Liverpool and Manchester.

At St. George's Hall in Liverpool was held an exhibition of historical and pictorial data relating to the Liverpool & Manchester Ry. This included such items as a photograph of the first page of the Minutes of the Directors for Tuesday, May 30, 1826; original stock certificate and other items relating to the building of the road. In addition there were 55 models of locomotives on English Railroads. In this hall was probably assembled the most complete collection of data relating to the history of the Liverpool & Manchester Ry. ever under one roof.

At Wavertree Playground there was a full size model of the famous "Rocket," "North Star", "Lion"—this was the original engine built in 1838 and was used to haul the "Train of 1830" on the Ring Railway in the playground. Here also were stationed the "Royal Scott" class of engine, the "King Stephen" and the "Lord Nelson" engines. In all there were 34 exhibits.

Each evening the "Pageant of Transport", lasting two hours was given. This included such items as the sled, sedan chair, the pack horse,

Roman chariot, Egyptian dray, and finally the survey and the opening of the Liverpool & Manchester Ry.

The authorities are to be congratulated for their efforts in staging this celebration. It is to be regretted that the elements were not so kind as many of the days it rained, but there is no doubt but that much good will come from this assemblange of so much material relating to the Liverpool & Manchester, the first railway in England.

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## CELEBRATION AT LOWELL, MASSACHUSETTS

On June 5, 1830, the legislature of Massachusetts granted the charter for the building of the Boston & Lowell Railroad, between those two cities, a distance of twenty-six miles. While the Granite Railway was built in 1826, this road was only three miles long and used for the transportation of granite for the building of Bunker Hill Monument. As early as 1807, Silas Whitney of Boston built a tramway of two feet gauge for the carrying of bricks, the loaded cars being forwarded to the foot of Beacon Hill while the empty cars were drawn to the top. The Boston & Lowell R. R. however, was the first road in New England to be constructed for the transportation of passengers and freight.

On June 5th of this year (1930), the Boston & Maine R. R., the present operating company, together with the City of Lowell, celebrated the one hundredth anniversary of the granting of the charter of the Boston & Lowell R. R. In the Lucy Larcom Park, near the site of the first station in Lowell, a bronze tablet was dedicated and with it was laid a twelve foot section of track made from parts of the original road —granite substructure and fish-belly rails. There was also a replica of Stephenson's "Rocket", loaned for the occasion, and one of the modern locomotives of the Boston & Maine R. R.

The present celebration was attended by the officials of the State of Massachusetts and of the Boston & Maine R. R.

Although the Boston & Lowell R. R. was the first road to be chartered in the State of Massachusetts, it was not opened for traffic until June 24, 1835 and was preceded in point of operation by both the Boston & Worcester and Boston & Providence Railroads.

On October 1, 1887, the Boston & Lowell R. R. was leased for 99 years by the Boston & Maine R. R. During that time it had built additional mileage and had acquired such roads as the Nashua & Lowell, Northern (New Hampshire), Connecticut & Passumpsic River, and Boston, Concord & Montreal Railroads. In 1919 the Boston & Lowell was consolidated with the Boston & Maine Railroad and is now a part of the Southern Division.

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# *Locomotive Performance of Nearly One Hundred Years Ago*

By Chas. E. Fisher

The Boston & Worcester R. R. was opened to Newton, a distance of eight miles, on April 16, 1834 and was the first railroad in operation in the State of Massachusetts. Through the foresight of one of the now retired officials of the present Boston & Albany R. R., there has been preserved and is now in my possession, the book recording the performance of the engines of the Boston & Worcester R. R., the first winter that road was in operation.

The pages indicate the name of the engine and engineer, "from and to what places", the mileage, hours on the road, the load, days lost on account of repairs and remarks. It is these remarks as set against each day and locomotive that make this book of genuine interest.

Whether any previous records were kept prior to the first entry in this book which is January 14, 1835, I doubt if we will ever know. There were three engines on the road, the "Meteor" with I. Leech for engineer, the "Yankee" with Cummings for engineer and the "Comet" with Guthrie for engineer. In the back of the book we note the "Meteor" was "put on the road" on April 2, 1834, the "Yankee" on July 3, 1834 and the "Comet" on January 21, 1835. Apparently the "Comet" had just arrived when this book was started.

The road, at the beginning of this journal, was opened as far as Westboro, a distance of 32 miles. Under favorable conditions, a round trip was made in a day, the "hours on the road" varying from four to five hours and some times longer.

The first notation we have is to the effect that the road is much "hove" by frost and is in bad running order and that they have to run slow.

Jan. 19, 1835—"Meteor". Engine is "hawled off" to have new "excentricks" made and put on.

Jan. 21, 1835—"Comet"—This is the engine recently arrived and on this day the run was made from Boston to Westboro on a passenger train in two hours. This was the first time that Engineer Guthrie had run through.

Jan. 22, 1835—"Comet"—The return trip from Westboro was made in safety.

Jan. 23, 1835—"Comet"—In running a passenger train from Boston to Framingham, on the return trip the cross head bolts broke and they were obliged to back in with one "engine"—we suppose the writer means cylinder.

Jan. 31, 1835—"Comet"—On this day this engine is assigned to a freight train evidently consisting of the following:

| | |
|---|---|
| 270 rails at 200 lbs each | 27 tons |
| 9 cars at 1¼ tons each | 11¼ tons |
| 1 tender at | 6½ tons |
| Total | 44¾ tons |

Went on levels 16 miles per hour. Reached Westboro in 3 hours 50 minutes. Steam failed several times.

Feb. 2, 1835—"Meteor"—Went down 1½ miles and brought "Yankee" and her passengers up. Her hose had frozen.

Feb. 7, 1835—"Meteor"—"Snow on rails, wheels revolve, but do not go ahead."

Feb. 5, 1835—"Yankee"—When opposite the poor house at Newton, ice on the track and in the curve, caused the engine to be derailed. Backed in after filling the boiler with water through valves account of hose being frozen.

Feb. 4, 1835—"Comet"—Engineer Guthrie evidently got as far as the crossing with the Providence road when the hose froze. The passengers were backed in and sent on by horses. The water was warmed in the tender and at eight o'clock the engine went out. On the return trip the pumps did not work freely at Framingham. At Needham the water was low but Engineer Guthrie could not tell where the level was in the boiler and about two hundred rods below the platform the leaden plug blew out and the engine had to be hauled in. The total time on the road for this day is 20 hours, 50 min.

Feb. 13, 1835—"Meteor"—One passenger car wheel shaft broke today. No other injury done. Five minutes detention.

Feb. 11, 1835—"Comet"—One of the freight car wheels broke and smashed car all to pieces. Did a little damage to the freight—detained about 20 minutes.

Feb. 14, 1835—"Yankee"—Engineer Cummins stated that at Needham it was found the pumps would not supply the boiler with water. Boiler was filled through the valves and at Framingham pumps were examined and found in good order. Dirt and a small piece of coarse bagging was found in the tender valves and after cleaned out, engine went well. The book bears the notation that strainers will be placed over all tender valves.

Feb. 21, 1835—"Meteor"—The strap that supports the boiler was broken because of the unevenness of the road.

Feb. 27, 1835—"Meteor"—On the eastward trip when only about 300 rods from Westboro, the broom scraper standard caught on the rail, broke the standard and derailed engine and tender down a six foot embankment and bent forward shaft of engine. Five pairs of oxen got the engine on the rails again and the down trip was made the day following.

Feb. 27,1835—"Comet"—Snowing, could not go fast for wheels slide on the snow. At Natick ran out of wood and water, went to Needham and took wood, backed to the Ledge and took water. Passengers were sent on by horses. About 2½ miles from Framingham hose froze and at Framingham the hose and pipes were thawed out. About ¼ mile beyond Framingham tubes burst in the boiler and engine was hauled back to Framingham by horses.

Feb. 23, 1835—"Yankee"—When coming around Parker's Hill, forward shaft of engine came apart in center where it had been attempted to be welded by Mr. Tufts, "but was not." Passengers brought in by horses and the "Comet" brought the "Yankee" in.

Mar. 2, 1835—"Yankee"—The cap over the valves was removed at 11 A. M. and proper care was not used in making the joint. Engine gave out at the Providence crossing and passengers were sent on by horses.

Mar. 14, 1835—"Comet"—Detained 45 minutes at Natick Ledge by the engine of a freight train being off the track. Detained 30 minutes more unloading a freight car and taking it off the track because the journals were broken.

Mar. 8, 1835—"Yankee"—Snow on the rails in some places six inches deep.

Mar. 10, 1835—"Yankee"—About two miles below Framingham the rails were covered with from two to six inches of snow. Left one freight and one passenger car at Natick. Got on with a great deal of trouble and at Parker's Hill the passenger cars were left. At Winship's crossing the engine became fast in the snow and "would not work herself out." Engineer Cummings remained with engine all night and brought engine and cars in the next morning.

Mar. 14, 1835—"Yankee"—At Natick pond, three journals on one freight car were found broken off short. "Took the car off the tracks and then went on."

Mar. 22, 1835—"Meteor"—"Snowing, hailing, raining and freezing." The "Meteor" and "Yankee" left Boston with 15 cars and a scraper. Went to Parker's Hill and had to leave one half of train, went on to Angers corner, backed down and hauled the hind cars up and carried this train to Charles River Bridge, pushed the front end to Needham, backed for the hind end of train and left it at Needham turnout. Got the front end of train to Framingham, left it and went to Westboro with the scraper arriving there at 8½ P. M.

Mar. 23, 1835—"Meteor" and "Yankee"—left with two scrapers, about three inches of snow and ice on the rail. At Natick Pond the scrapers got off the track. Left one and at Charles River the flange on a wheel of this scraper broke and it went down an 8 foot embankment. Left it, got seven men to shovel snow for ⅛ mile where the track was found to be clear. No injury was done to either engine or cars. "The 22nd and 23rd of March were hard days for the railroads."

Apr. 4, 1835—"Comet"—Detained at Parkers Hill 32 minutes by the rails being covered with mud and gravel and 25 minutes at Natick Ledge for the same reason. Were obliged to run one car through at a time.

Apr. 17, 1835—"Meteor"—On the return trip to Boston, about ½ mile below Westboro, the engine and tender were derailed. One of the "Air Spring" drawbars on "Whitmore Car" was broken and engineman went one mile before he found he had left his cars. Note: We cannot but wonder if the engine and tender were not placed on the rails before the engineman travelled one mile and found he had left half of his train.

Apr. 16, 1835—"Yankee"—When returning with seven freight cars from Westboro, they struck a cow near "Moss Hill," Natick. Engine and tender were derailed and "shaft of tender wheels bent", but no other damage was done.

Apr. 22, 1835—"Meteor"—The crank shaft on this engine broke at Natick. They obtained horses and put passengers and baggage into two cars and went on with only 25 minutes delay.

Apr. 25, 1835—"Yankee"—Snowed all day. Used the snow plow from Westboro to Framingham and was three hours getting through and two hours and 33 minutes more from Framingham to Boston.

May 7, 1835—"Col. Long"—When returning from Westboro with four cars of freight, about two miles this side of Westboro, the forward shaft broke into three pieces and detained passenger train until 6:30 in getting the engine to Westboro. "The Colonel is a total wreck". For the information of our readers, the "Colonel Long" was sent to the Boston & Worcester R. R. for trial by the builders, Long & Norris in Philadelphia.

May 14, 1835—"Yankee"—Ashpan fell off at or near Six Mile Post.

May 26, 1835—"Rocket"—"First time on the road, performance good." This was a new engine and made the run to Westboro with 9 cars of rails.

June 5, 1835—"Comet"—Broke the forward shaft inside the hub at Natick. Passengers sent on by horses.

June 18, 1835—"Comet"—Ran over two oxen at Natick and killed them. Cars were injured but not the engine. Passengers sent on by horses.

June 22, 1835—"Rocket"—Tender shaft broke inside the wheel. "Meteor" left her freight train and took passengers to Boston.

July 3, 1835—"Meteor"—At Newton forward shaft broke and passengers detained 3 hrs. 45 minutes, "Meteor" arrived at depot at 12:20 and had shaft repaired.

July 3, 1835—"Yankee"—The Directors were detained at Newton 3 hrs. 45 minutes by the breaking of the "Meteor's" shaft. Near the Providence road crossing the steam pipe burst near the throttle joint.

July 4, 1835—Against this date is the notation—"Everything went well today." The mileage of the engines indicates that the recorder of these events thought the distance from Boston to Worcester was 42 miles for there is this note—"Mr. Stuart, the distance per railroad to Worcester is 44 miles."

July 6, 1835—"Comet"—This engine pulled the train carrying the "stockholders and Ladies" to Westboro and Worcester. The engine "Meteor" also handled a similar train.

While we have so far concerned ourselves with the "incidents" during this early pioneer period, a statement as to what these locomotives were actually doing may not be amiss. Like all roads which were built subsequent to this one, the traffic proved larger than the locomotives and cars could well take care of. The three engines which this road had when opened as far as Westboro were not assigned to any train or run, but the engine and engineer ran, first in, first out, on either freight or passenger trains, when the engine was running. It was no uncommon thing for some of these engines to make over 500 miles weekly, of six days only, and the "Comet" from May 10-16th, made 672 miles. From June 8-13th, the "Meteor" also made 672 miles; the "Rocket", a new engine, made this same period, 768 miles and the same engine from July 6-11th made 756 miles. The time given in the last case is 54 hours and 5 minutes for this period or about 9 hours daily. The locomotives made a round trip over the road daily and in many cases a trip one way was also made over the road, making a total of 132 miles daily.

July 14, 1835—"Mercury"—This engine in charge of R. Adams, Engineer, made her first trip to Worcester and return on a freight train.

July 22, 1835—"Rocket"—Guthrie, Engineer of the "Mercury", ran his train carelessly, so the records state, into the "Rocket's" train, injuring the foot of Samuel Kernaghan. This was the first accident in which a person received injury on the road. Before closing it may be well to state that Guthrie's name no longer appears in the records of this book.

July 25, 1835—"Mercury"—At Westboro, Mr. Hale who had brought this engine down to Framingham, on his arrival there the "gates" were against the engine and engine and tender were derailed and had to stay there all night. "Springs were much set."

July 30, 1835—"Comet"—"Hawled up for repairs."

Aug. 5, 1835—"Rocket"—At Parkers Hill, five miles out, a piece of timber used for crossing rail on turnout was on the track. Engine was thrown off one spring broken, both tender shafts broken and one square passenger car "broken to pieces, but the 15 persons who were in it were not hurt."

Aug. 7, 1835—"Jupiter"—Near the Brighton road crossing a cow was seen by the engineer 20 or 30 rods ahead of the engine. The engine was pulling a freight train and running slow and the report states the cow crossed to the left side of the track and began to feed. The engineer opened his throttle in hopes of passing the cow, but the cow turned back and the engine struck and killed her. "She was not dead when the owner came to bed her." The "Jupiter" mentioned here is a new engine and the first trip was made on Aug. 5th. There is some doubt in the mind of the author from these records whether it was the "Jupiter" or the "Mercury" that killed the cow.

Aug. 20, 1835—"Rocket"—At Grafton the set screw of dog loosened. The engineer backed the engine to Worcester, turned the engine and then backed the engine and train towards Boston. A note on the same date states the "Mercury" was sent out to find the cause of the delay of the passenger train.

Aug. 26, 1835—"Rocket"—At Newton the engine ran off the track and the "Comet" took the passengers to Worcester. The "Rocket" was backed to Boston and the spokes of the front driving wheels were found too loose for the engine to run until new wheels were applied.

Sept. 7, 1835—"Yankee"—The driving dog broke when going from the engine house to the cars. "Comet" went out with the passengers.

Sept. 18, 1835—"Comet"—At Framingham the "Gibb" in the connecting rode broke, detained 65 minutes making a new one. Three spokes broken in the forward wheels and all the others loosened. A notation follows to the effect that a pattern was made and that new cast iron wheels were in on Oct. 2nd.

Sept. 26, 1835—"Jupiter"—About 1½ miles above Westboro, the engine struck a rock, broke the box on the forward shaft, bent struts on both sides, broke two boxes on tender, one wheel on baggage car and broke one passenger car "considerable and done other damage."

Sept. 28, 1835—"Meteor"—Crank shaft broke, came in and got horses, went to Newton with passengers and took down engine.

Oct. 1, 1835—"Jupiter"—Crank shaft broke, passengers brought in by horses. Three spokes in the large wheels broken and all the others loose.

Oct. 1, 1835—"Mercury"—Crank shaft broke. Evidently the writer thought further explanation was useless.

Oct. 7, 1835—"Comet"—Engine would not steam. Five hours and 25 minutes were used on the up trip and at Worcester the netting was found choked.

Nov. 2, 1835—"Mercury"—Valve stem in throttle rusted. Was taken out and oiled. Worked well.

Nov. 4, 1835—"Mercury"—Thrown off the rails and ditched at Winships by road repairers leaving their cart on the track.

Nov. 22, 1835—"Mercury"—Snowed all day. Got to Westboro at 6 P. M., put passengers into stages and sent them on to Worcester. Backed to Framingham and took passengers to Boston that had come from Worcester by stages.

Nov. 30, 1835—"Comet"—Left three cars at Angers Corner and one at Hopkinton. Put the snow plow behind going up and left it off the track at Framingham.

Nov. 30, 1835—"Meteor"—Broke crank shaft and engine brought in by the "Jupiter". The "Meteor" has broken two crank shafts that were made at Bridgewater.

Dec. 1, 1835—"Mercury"—Team was on Milldam Bridge going towards the gravel bank. Engine struck the horses and killed them. Forward wheels of the engine went off the track and 12 freight cars were partly off the track. "Damage very trifling."

Dec. 18, 1835—"Rocket"—Supply pipe burst again. Cut out a piece and found that it was stopped up when brazed in England. Note: We wonder if this can be true. While the supply pipe did burst on the 17th inst., the records show that very little trouble had been experienced prior to this date. Surely in the seven months the engine had been in service this trouble would have been encountered long before this.

Dec. 22, 1835—"Comet"—A rail was placed on the track at the gravel bank. Engine went over it, bent crank and forward shafts and broke all of her springs.

Dec. 24, 1835—"Rocket"—Waited 20 minutes at Framingham for freight train. Large wheels are very bad—spokes are loose.

Jan. 5, 1836—"Comet"—Commenced snowing at 2 P. M. Had to leave passengers at Needham. Got in at 12:30 Night. Snow in places 10 inches.

Jan. 6, 1836—"Comet"—On this day, this engine together with the "Rocket" made the trip to Needham to pick up the passengers left there the evening previous.
On a later trip to Framingham the broom car wheels broke and engine was thrown off the track and forward shaft was bent. "Had to back in."

Jan. 9, 1836—"Jupiter"—Snow on the rails. Got to Needham at 7 P. M. and could proceed no farther.

Jan. 15, 1836—"Comet"—Baggage car struck car house door. Went off the track, stove end of "knickerbocker" and broke post that car doors hang to.

Jan. 25, 1836—"Mercury"—Engine was sent out to clear the track, got as far as the bridge and broke end frame of engine. Hauled back to Worcester by oxen.

Jan. 24, 1836—"Lion"—This is a new engine and the report states—"first trip, runs well, in good order. The engine went to Worcester and back.

Jan. 25, 1836—"Lion"—On account of three feet of snow on the track at Brookline, this engine with the "Jupiter" could go no farther. The next day the rails were cleared.

Jan. 27, 1836—"Lion"—In Worcester the gates were on the wrong track and the engine and the entire train left the rails.

Jan. 28, 1836—"Jupiter"—At Grafton the tender bolt broke and engine hose was broken off. "When men went to shove her out she was froze and the pump broke and plunger was bent."

Jan. 29, 1836—"Yankee"—Piston head loose, works well only does not make steam.

Jan. 31, 1836—"Comet"—Snow on the track. Went with the "Mercury" to open the road and was nine hours getting to Worcester. Snow two feet deep on "N" plain.

Feb. 4, 1836—"Comet"—Hose came off, got under wheel and broke supply pipe and pump.

Feb. 8, 1836—On this day the "Lion" and Jupiter" left with the snow plow and got as far as Natick when they became stalled in the snow. The "Yankee" was despatched and got them to Needham Depot. On the 12th these three engines tried to clear the line and got as far as Westboro. There are no entries that a single engine turned a wheel on Feb. 9th, 10th and 11th.

Feb. 13, 1836—On this day three engines "Lion", "Yankee" and "Rocket" got as far as Westboro and the "Rocket" got through to Worcester. From the west end, the "Mercury" and "Comet" got through to Boston.

Feb. 20, 1836—"Rocket"—Left Westboro at 12 Noon and "unhitched" five cars. Got as far as Natick pond with four and could get no farther. Left cars on siding and backed up to Framingham and then had to back to Westboro to assist the "Lion" on the passenger train.

Feb. 25, 1836—"Rocket"—Sent to Grafton, 12 miles, to pick up the freight cars left by the "Jupiter" in consequence of a strong head wind.

Mar. 1, 1836—"Mercury"—Ice on the rails, left 6 cars at Westboro, 9 hours going to Worcester. Note: Needless to say because of the severity of the weather, the engine mileage was not as large in winter as in summer. However, for the week ending March 5th, this engine made 612 miles. This engine made a similar mileage in January. Other engines were making from 300 to 550 miles weekly.

Feb. 28, 1836—"Yankee"—Engine with the "Jupiter" got as far as Needham and engine, tender and freight cars left the track and were on the ice. Tender shaft was broken, one car wheel was broken and two shafts bent, "etc. etc." Note: Between Feb. 28th and Mar. 5th, four broken car wheels and two tender axles, "shafts" caused trouble on the road.

Mar. 11, 1836—"Lion"—Axle of freight car broke in the center and 11 cars were thrown off the track and down an embankment. "Two are not worth repairing." On leaving Worcester one axle on an empty freight car broke.

Mar. 12, 1836—"Rocket"—At Westboro pumps froze going up and at Grafton when coming down the pumps would not supply engine. The "Meteor" left her freight train and took the passenger train to Boston. Examination showed dirt and chips in the valves.

Mar. 9, 1836—"Meteor"—Has a new crank shaft made by Sylvester & Co. "Runs well".

Mar. 8, 1836—"Mercury"—Tire on large wheel loose. Taken off to be "resot."

Mar. 21, 1836—"Lion"—18 cars on Needham curve. Had to leave part by going up to turnout and then return for the rest of the train. Cylinder joints are beginning to give out.

Mar. 25, 1836—"Lion"—Joints on cylinder head (inside) "blowed" out. Arm on rocker shaft loose.

Mar. 23, 1836—"Rocket"—This engine ahead of the "Jupiter" with a new snowplow on account of three inches of snow on the track, derailed the snowplow at the gravel bank and "Half of nose broken off." Went as well with shovels in front of broom standards.

Apr. 5, 1836—"Lion"—At Worcester Ledge a large rock lay on the rail, fender of the engine struck the rock, rolled it out of the way, but the rock when it rebounded from striking the ledge, struck the tender with such force as to derail the tender.

Apr. 13, 1836—"Wm. Penn"—Was put on the road this day. Had a groove cut in her under frame for bolt of slide to run in. This was done by order of Mr. D. Henshaw.

Apr. 19, 1836—"Rocket"—At Southboro tender shaft broke. Took wheels from passenger car and put them under tender and came in. Detained 1 hr. 25 min.

Apr. 19, 1836—"Wm. Penn"—17 cars up, runs well.

Apr. 20, 1836—"Wm. Penn"—19 cars up, had to double on Needham curve.

Apr. 22, 1836—"Wm. Penn"—13 cars up. Had to take water at Needham each time.

Apr. 20, 1836—"Jupiter"—Engine was sent to Framingham to remain there "until wanted".

May 7, 1836—"Meteor"—Thirty feet of wall in Worcester Ledge fell into the road. Passengers could not leave until 5 P. M.

May 1, 1836—"Wm. Penn"—20 cars loaded and one empty car.

May 3, 1836———"Yankee"—18 cars.

May 5, 1836—"Mercury"—Engine sent to Framingham to remain until wanted.

May 11, 1836—"Comet"—"At Parker's Hill, brought up too quick, 9 cars were thrown off track, 2 journals bent, one box and some couplings broken."

May 17, 1836—"Meteor"—In Worcester Ledge a "dirt car" struck a passenger car and tore off the mouldings and steps. The "Jupiter" is now in service and running on the gravel train while the improvements are being made at Worcester Ledge.

June 11, 1836—"Lowell Engine"—First time on the road, runs well. This engine afterwards appears in the records as the "Lowell."

June 20, 1836—"Yankee"—Left Worcester at 6:18. Stopped in ledge for want of steam for 15 minutes. Arrived at 9:05, running time 2 hrs. 32 min. Valves worn out and broken.

June 25, 1836—"Lowell"—"Rocker shaft broke, etc."

June 21, 1836—"Wm. Penn"—Sent to Worcester to remain until wanted.

June 22, 1836—"Jupiter"—Sent to Framingham to remain until wanted.

July 5, 1836—"Mercury"—With engine "Lion" leading to Framingham. At Newton the gate was out of place and 2nd and 3rd cars went off the track. The end of the New York car was broken in. Detained 12 minutes.

July 9, 1836—"Meteor"—Engine sent to Worcester until wanted. These engines that were either stored or used for "spare" should not be taken seriously as it was not long before they were in service again. Thus on the 6th inst. the "Wm. Penn" made a trip from Worcester to Boston and on the 8th and 9th inst. was on the gravel train.

July 14, 1836—"Mercury"—Crank shaft broke, struts on center bearing broke, two stringers broke and one bent, one connecting rod bent, two center boxes broken, shaft broken short off outside of left crank and inside of right crank and bent in center. The train went 33 rods after shaft broke and wheel went off rail.

July 12, 1836—"Lowell"—Safety valve joint blew out.

July 13, 1836—"Lowell"—Rocker shaft and eye on dog broke. Left freight train and came to Boston.

July 16, 1836—"Yankee"—In backing out with the passenger cars for the 11 o'clock train, wheel on the right crank shaft came loose and the "Wm. Penn" went with the train.

Aug. 2, 1836—"Yankee"—At Hopkinton key in piston rod was gone. Put in an old rail key but that loosened at Grafton. Broke the brace between the slides and left passengers and went to Worcester with one "engine". "Lowell" went down and brought passengers up, arriving at Worcester at 8:10 P. M.

Aug. 2, 1836—"Lowell"—On the Director's train. Was only 1 hr. and 35 min. running to Worcester.

Aug. 24, 1836—"Yankee"—Went as far as Parker's Hill and crank shaft broke and one stringer was broken.

Sept. 7, 1836—"Wm. Penn"—Came into the depot too fast. Could not stop until five cars had run off the track at the gate. This engine was in service between Boston and Newton on the gravel train. Note: In looking over the mileage made by these engines during the summer, the rule seemed to be that these engines made three 44 mile trips daily, when they were able, and when they were not, one of the spare engines were used. Thus, if an engine met with no trouble, it

would make 794 miles weekly (six days) during the summer, many of the engines were doing it and with the amount of gravel the road was hauling, practically all of the engines were in service.

Sept. 12, 1836—"Lion"—Coming through Brighton at 9 P. M. the train ran into a drove of cattle killing two of them. "It was so dark, could not see."

Sept. 11, 1836—"Wm. Penn"—Tank sent to Adam's at South Boston to be enlarged by adding 12 inches in height.

Sept. 21, 1836—"Comet"—Switch on bridge was wrong. Engine and cars ran off the track, baggage car was slightly injured by rail of bridge running through it. Engine springs were set. "Meteor" went on with the passengers.

Sept. 23, 1836—"Lion"—Netting "gummed" up. Detained 25 minutes washing it.

Sept. 26, 1836—"Comet"—At 8:48 A. M. sent from engine house to freight house at Worcester. Met passenger train on curve in freight depot and was thrown off the track bending the crank shaft, supply pipe broken and strut for spring broken, "etc". Note: strange as it may seem the records do not show the name of the engine pulling the passenger train and what happened to them. Engineer Sawyer was in charge of the "Comet" but this accident did not terminate his services. So far as the records show this is the first collision that took place on the road, and perhaps the management felt that as the "Comet" got the worst of it, nothing more need be said.

Oct. 6, 1836—"Jupiter"—At Brighton the down train was detained 1 hr and 48 min by pump joint on boiler blowing out. Passengers were pushed in by the "Meteor." "No injury to persons or property."

Oct. 20, 1836—"Wm. Penn"—Strong head wind with rain. Had to double on all hills.

Nov. 17, 1836—"Mercury"—In Brighton a cow on the track broke both supply pipes when the engine passed over her and four cars were derailed. "Run into the old Depot with safety!!"
The location of the stock yards at Brighton caused the road much trouble with sheep and cattle being on the track.

Dec. 6, 1836—"Yankee"—When passing under the Washington Street Bridge, the smoke pipe was broken off. Found that the height of the bridge from the rail was only 13 feet 3 inches.

Dec. 17, 1836—"Jupiter"—At Jackson's cut, clay and gravel on the track derailed the engine, tender and one box car. Engine went down a ten foot embankment and finally stopped wheels up in the air breaking forward shaft of engine and doing considerable damage to the machinery.

Dec. 23, 1836—"Lion"—Snow on rails. Had to leave freight train at Grafton and run to Worcester. Got the "Yankee", backed down and took up freight.

Jan. 6, 1837—"Yankee"—Snow on rails. Left freight at Westboro and went to Worcester so as to be ready to help with the passenger trains if wanted.

Jan. 6, 1837—"Mercury"—At Grafton, ice on the rails, engine, tender and baggage car went off the track. Got oxen and hauled them on. Thimbles in the tubes were loose and 22 were reset. The first day of the New Year was a busy one because of the snow and required much double-heading on the road.

Jan. 22, 1837—"Yankee" and "Lion"—Sunday. Left Worcester with new snow plow and went through drifts from 3 to 6 feet deep until within 30 rods of Grafton Depot when the snow plow went off the track and ran against a stone wall. There

was three inches of ice on the rails at this point. One side of the plow was broken off. After this they had hard going as they could only clear one rail. Went on until about a mile from Westboro where they stopped for the night, plow was broken, wood almost gone and snow four feet deep for a quarter of a mile ahead. Twelve miles were covered this day.

Jan. 23, 1837—"Yankee" and "Lion"—Had engines hauled to Westboro, plow repaired and ready to start at 3 P. M. Almost reached Southboro and learned that very little had been done from that point to Hopkinton so returned to Westboro and arrived at 8 P. M. Ten miles cleared and run and only one scraper left on plow.

Jan. 24, 1837—"Yankee" and "Lion"—Left at 8 A. M. and within one mile of Hopkinton found four feet of snow. Broke the crust which was six inches thick and ran through to Hopkinton. From there the road was fairly well cleared until we arrived at Framingham. From Framingham to Natick nothing had been done. We got three ox teams to go ahead and break the crust and did some shovelling until we arrived at Natick. At that point there were seventy-two men shoveling snow and right behind them were two engines and the passenger train. We let them pass us and arrived at Boston at 6 P. M. The crews made 32 miles this day and no damage done to either engine. Mr. Stuart, the signer of this report, states that had not the ice on the rails broken the plow they would have been in Boston, Monday noon.

Jan. 22, 1837—"Lowell"—The story on the east end is much the same. On this day this engine with the "Comet" and "Mercury" and the "Baltimore snow plow" got as far as Brighton road crossing. The next day owing to bad weather they got as far as Brighton crossing and had to return. That night they got as far as the Newton poor house. On the first trip Tuesday they got as far as Needham and because they were out of water had to back in again. Started once more and at Natick found the down train waiting for them.

Jan. 31, 1837—"Lion"—The nails under the poor house bridge have been "hove" by frost and the chimney of the engine strikes the bridge. Road is in very bad shape due to the frost.

Feb. 28, 1837—"Comet"—Ice, snow and water on the rails. Only one engine got to Boston at 5:10 P. M.

Feb. 27, 1837—"Mercury"—Hose worked off the tender, got under the wheels and broke the pump.

Mar. 3, 1837—"Lowell"—Joints in steam chamber, cylinder head and valves "gone". Note: The month of February was a severe one for the railroad. The storms caused much double heading and delayed the trains but because of the similiarity of these reports, they will be omitted here.

Mar. 15, 1837—"Comet"—Snow plow ahead. Went off the track at Newton and left the plow there. 3½ hours going up because of foul water from South Cove.

Mar. 15, 1837—"Lion"—No water at Framingham. Dirt got washed into the well for want of a curb on the top.

Mar. 14, 1837—"Jupiter"—When passing over a gully which had been washed by rain, the crank shaft broke and engine and tender went down a fifty foot embankment. Neither engineer or fireman were injured and the cars remained on the track. The "Lowell" left her freight train and pulled the passenger cars to Boston.

Mar. 17, 1837—"Lowell"—Ashpan came off at Hopkinton on the up trip.

Mar. 30, 1837—"Mercury"—Strong head wind this morning and it took 3 hr., 35 min. to go up on the passenger train.

Apr. 22, 1837—"Elephant"—A new engine. Made a round trip to Worcester on a freight train and "runs well."

May 22, 1837—"Lion"—It is interesting to note that this engine which handled a passenger train also handles three cars of merchandise. Whether this was "mixed" service or to expedite the freight, the records do not show. It did not continue long as will be noted in a subsequent report.

June 6, 1837—"Lion"—At Newton, a freight car axle broke and caused two freight cars, two passenger and one baggage car to be broken up and a detention of forty minutes to the passengers. Note: There are no further instances of freight cars being used on passenger trains.

July 2, 1837—"Lion"—On this day this engine is credited with hauling a passenger and mail train. This is the first instance, in this book, where mention is made of the mail service.

July 4, 1837—"Yankee"—"Found the bridge burned down over the Charles River and took the passenger train back to Worcester."

July 13, 1837—"Mercury"—At Natick a freight car axle broke. Took the freight out, loaded it in another car and pulled the damaged car off the track.
It is interesting to note at this point that the "Lowell" from July 9th to 15th incl. made 880 miles, three trips of 44 miles each on every day save one and that the "Lion" for the same period less one day, made 748 miles, making three trips daily save one day.

July 22, 1837—"Mercury"—Key in the connecting rod came out, connecting rod was bent, pin in cross head was bent and piston rod was bent. The notation states—"Was running entirely too fast."

July 26, 1837—"Lowell"—At Grafton, tender axle broke on the up 4 P. M. passenger train. Ran the engine alone to Worcester, got another tender, backed down and hauled train in to Worcester. This is not the first instance in which the tender has either been derailed or suffered an accident and the engine has run to the nearest point for another tender. The records state that extra tenders were held for just such emergencies.

Sept. 6, 1837—"Lion"—Apparently an express train of some sort has been added to the passenger schedule for this engine is running on a schedule of 1 hr. and 17 min. from Boston to Worcester.

Sept. 8, 1837—"Lion"—The report states that Engineer Bullard arrived 15 minutes before his time, making the running time in 1 hr. and 2 min.

Sept. 17, 1837—"Comet"—Water got low in the boiler and fire was put out. Continued as long as the steam lasted. Had to stop and get up steam and met up train at Hopkinton.

Sept. 20, 1837—"Comet"—At Natick lost the nuts from the packing box on piston rod and packing blew out. "Elephant" left her freight train and took passengers to destination.

Sept. 21, 1837—"Meteor"—"Steam high, water low, solder melted out of dome. Engine sent to machine shop for repairs."

Oct. 3, 1837—"Rocket"—"Ran over a drunken man. Some bruises. He is getting better."

Oct. 11, 1837—"Wm. Penn"—Engine foamed too much. Had to blow her off. The trip was made only as far as Brighton. On the next trip the "water worked much better."

Oct. 18, 1837—"Yankee"—Here we have an instance where the guys of the derrick were too low and they took the corner off a milk car that was in the "Yankee's train."

Oct. 20, 1837—"Mercury"—On account of foul water the engine was delayed in getting her train to Worcester. On the next day, at the first bridge above Westboro there were some dirt cars on the track and the "Mercury" and train collided with them smashing three of them, breaking the arch of the engine and the frame, and derailing the tender, baggage and "forward" passenger cars. Engineer Farwell was slightly hurt. He stated he could not see 20 rods ahead in the curve where the cars were.

Oct 30, 1837—"Yankee"—At Charles River the engine, tender and two passenger cars went off the track because Engineer Farwell did not see that the switch was properly set. Engineer Farwell was the only one injured, his hand being so badly hurt as to make amputation necessary. There follows two notations that the gates at Charles River may be seen at 525 feet distant, the other states at 31 rods.

Nov. 9, 1837—"Wm. Penn"—Pumps would not supply engine. Joint on cylinder head gone. Engine sent to South Cove Shop.

Nov. 11, 1837—"Wm. Penn"—Joint on cylinder gone again. Engine sent to South Cove Shop.

Nov. 24, 1837—"Rocket"—This engine while pulling the train carrying the Directors over the Millbury Branch, evidently just opened, collided with a train of coal cars, smashing four of them and breaking the smoke arch and steam pipe of the "Rocket". "The coal cars were sent out by Mr. Jackson contrary to orders." Which engine was attached to the coal cars or which one was despatched to the scene to pull the Directors home, the records do not show. Let us hope they were not pulled home by horses!

And here the remarks which have been so interesting and so valuable to throw light on the early days of railroading cease and we wish it could be continued further.

These engines were built as follows:

| | | | |
|---|---|---|---|
| "Meteor" | Robert Stephenson | 1834—first trip | Apr. 2, 1834. |
| "Yankee" | Mill Dam Foundry | 1834—first trip | July 3, 1834. |
| "Comet" | Robert Stephenson | 1834—first trip | Jan. 21, 1835. |
| "Rocket" | Robert Stephenson | 1835—first trip | May 26, 1835. |
| "Mercury" | Robert Stephenson | 1835—first trip | July 20, 1835. |
| "Jupiter" | Robert Stephenson | 1835—first trip | Aug. 5, 1835. |
| "Lion" | Edward Bury | 1836—first trip | Aug. 24, 1836. |
| "Wm. Penn" | Baldwin | 1836—first trip | Apr. 13, 1836. |
| "Lowell" | Locks & Canals Co. | 1836—first trip | June 11, 1836. |
| "Elephant" | Baldwin | 1837—first trip | Apr. 22, 1837. |

In the back of the volume, the "recorder" has given us the mileage of the six engines for the year 1835 (eleven months only):

| | | | |
|---|---|---|---|
| "Meteor" | 11 months | 1835 | 11224 miles. |
| "Comet" | 11 months | 1835 | 21187 miles. |
| "Yankee" | 11 months | 1835 | 14194 miles. |
| "Rocket" | 8 months | 1835 | 11876 miles. |
| "Mercury" | 6 months | 1835 | 9668 miles. |
| "Jupiter" | 5 months | 1835 | 11372 miles. |

In the report which was made the subject of our Bulletin No. 13, we find the engines built in America weighed nine tons, while those built by Stephenson weighed six tons. The "Lion" also weighed nine tons. The larger engines carry on an average 15 cars of freight between Boston and

Worcester, making a total gross load of 64.2 tons. The smaller engines carry only about five cars of freight making a total gross load of 26 tons.

"The smaller, or six ton engines, are found to be very uneconomical, being more subject to derangement, and carrying much lighter loads than the nine ton engines, with the same cost of agents, and nearly the same expense of fuel. It is stated that upon the four smaller engines, (all made by Stephenson) eleven cranked axles had broken in 2½ years' use."

The expenses in connection with the working of these engines is given fully in Bulletin No. 13 and we will not repeat here.

In giving these "remarks" as found in this early record book, I have followed the wording of the "recorder" as closely as possible. These records serve to give us an idea of what early railroading was, something that it is difficult for us in this day to appreciate. For this reason they may serve to be of interest to our members.

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## CORRECTIONS TO BOSTON & ALBANY R. R. LIST OF LOCOMOTIVES.

Since the publication of the list of Boston & Albany R. R. locomotives that was published in Bulletin No. 22 in which a few typographical errors occurred, a few additional corrections have been found and the following corrections and additions should be made to have a correct list.

Page 10—Line 13—1st N Y C #396 should read 392.
Page 10—Line 14—The #106 should be omitted.
Page 10—Line 29—The "Kentucky", Hinkley, 1876 was built by the B & A 1876.
Page 10—Line 38—The original #11, B & A, 1876, like its predecessor carried the name "Virginia".
Page 11—Line 25—Following this line a line has been omitted. There was a "Georgia", Orig. #19, B & A 1874, 4-4-0, 18"x26" 60" which preceded the second #19, new #281 which did not carry a name.
Page 12—Line 11—The original #27 should be omitted.
Page 13—Line 9—The "Champion" was renamed "Marmora."
Page 14—Line 28—The "Switcher" was built by Norris.
Page 15—Line 11—1st N Y C #2535 should read 2534 and B & A 1912 number should be 906.
Page 18—Line 4—The "Brookfield" #109 also carried the new #209.
Page 18—Line 20—The "Wm. Penn" was built by Baldwin in 1836.
Page 21—Line 37—The new #163 was Orig. No. 11 and later 285.
Page 21—Line 38—The "W. Bliss" #164 was new #264 1st N Y C #1215.
Page 22—Line 1—The new #164 was Orig. No. 12 and later 286.
Page 22—Line 9—The 2nd 168 carried the new #168 in place of 163.
Page 23—Line 23—The 2nd 164 was Orig. #12, later #286.
Page 24—Line 17—The 2nd 213 carried new #128 in place of 123.
Page 25—Line 4—The 2nd 127 carried N Y C #2520 in place of 2620.

The opening statement on Page 31 is incorrect as in addition to the "Berkshire" there were six American type passenger engines still in service. They are Nos. 208, 211, 212, 286, 288 and 290.

Also, a clipping has been noted which states that the old "Brookline" was renamed "Z. E. Coffin". The old "Brookline" appears in the list of 1865 and in the list of 1866 the "Brookline" is omitted but the "Coffin" appears. From what can be learned the "Brookline" was rebuilt by Hinkley to a 4-2-0 type and the engine renamed "Z. E. Coffin". The engine was found to be too light for the service required and it was sold to the Penobscot & Kennebec R. R. where it was renamed "Farmingdale". There is no connection between the "Z. E. Coffin" and the "Victor" as shown in the B & A list on Page 20.

While the authors regret that these inaccuracies appeared in the original list as published in Bulletin No. 22, the arrangement and compiling of this list was no small job. The above corrections should be added to the original list that appeared in Bulletin No. 22.

# *The Canterbury and Whitstable Railway*

By Rev. Reginald B. Fellows

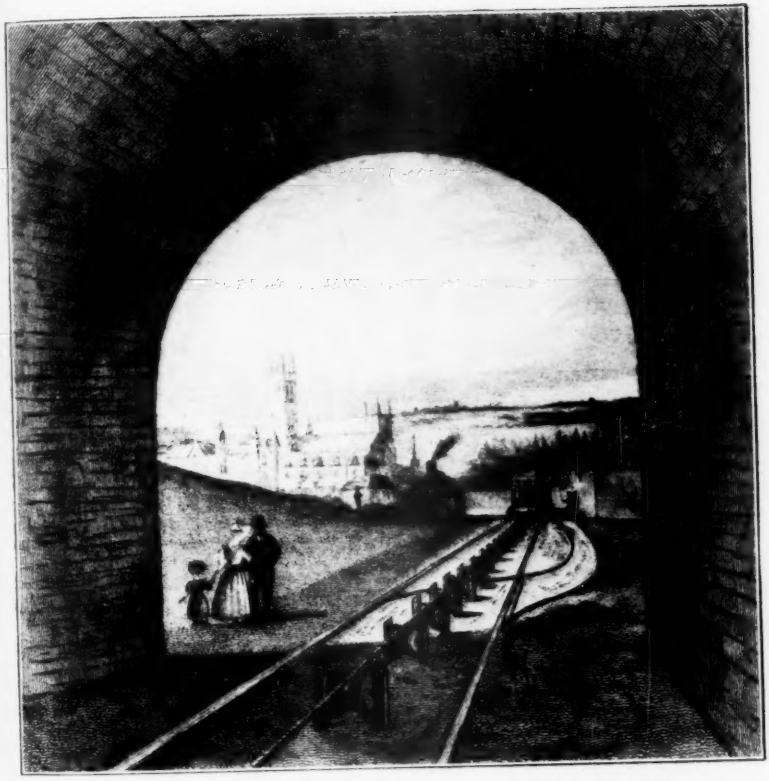
IN Mr. D. S. Barrie's interesting article on the centenary of the Liverpool and Manchester Railway published in Bulletin No. 22, he refers to the Canterbury and Whitstable line which celebrated its centenary some four months earlier than the northern line, and states that its only claim to recognition by the railway historian is the peculiar insistence of its promoters upon the inclusion in the system of a tunnel as a desirable novelty though both useless and expensive.

It is quite true that in most of the accounts of the Canterbury and Whitstable railway that have been published during the last twenty-five years currency is given to the story that a line of country was especially chosen for the railway where a tunnel could be made, it being thought that passengers would be attracted to the railway by the novelty of a tunnel. The story is given in C. E. R. Sherrington's "Economics of Rail Transport in Great Britain" (1928) Vol. 1, p. 12, and in W. J. Gordon's "Our Home Railways" (1910), Vol. 1, p. 183 (to mention only two writers of repute). So common is the story that it is actually embodied in the "Big Book of Railways", a charming book for very small children published by the Oxford University Press, and in the guise of a nursery story it is, I think, at its best. None of the writers give any reference to earlier or authoritative documents. Although I have searched the files of more than one Canterbury newspaper published contemporaneously with the construction of the railway, I have been unable to find any reference to this curious story about the origin of the tunnel, but it is perfectly certain from the early records that the promoters of the railway were anxious to have the most direct line possible between Canterbury and Whitstable, and in consequence rejected William James' earlier proposal for a circuitous line of greater length but with easier gradients. The route actually chosen on William James' final survey was about as direct as possible, as short as the turnpike road with which the railway was to compete for the carriage of coal, merchandise and passengers from Whitstable Harbour, but to secure this direct line either a cutting or a tunnel north of Canterbury was necessary. The construction of a cutting generally involves the purchase of a large area of land, and, at Tyler Hill, a bridge would have been necessary as well to carry the existing highway over the cutting near Brotherhood Farm. That a tunnel should have been made in preference to a cutting is not in the circumstances remarkable—it cost however a great deal more than was expected.

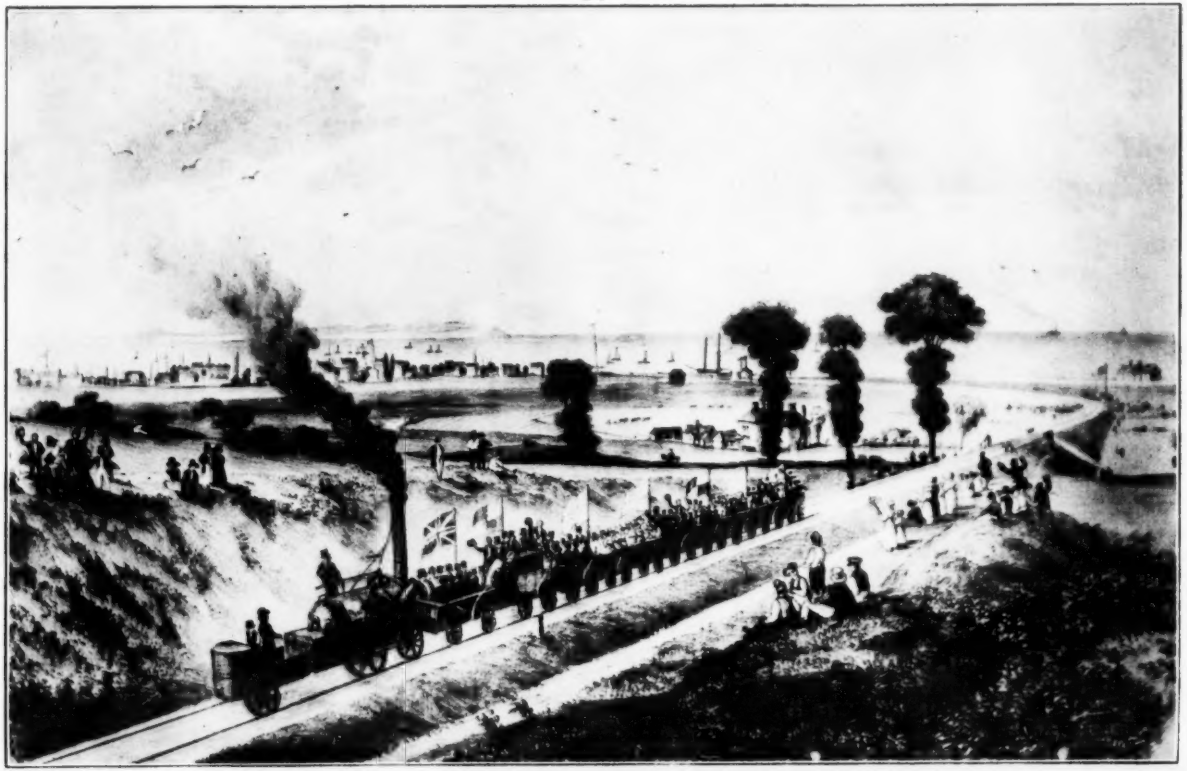
The tunnel was adversely criticised by the Editor in *The Railway Magazine and Annals of Science,* April 1836, as being dangerous from

the point of view of health, and so liable to make those who travelled through it catch cold that passengers were deterred from using the railway, but he makes no reference to the story that the tunnel was intended to attract passengers to the railway. Nor is there anything in a special article on the Canterbury and Whitstable Railway in *The Railway Magazine* of October 1835, which was illustrated by an engraving of the tunnel, to suggest that it was constructed for any other purpose than that of providing the most direct line between Canterbury and Whitstable. The engraving, which is reproduced here, is interesting as showing the sheaves and the rope with an open passenger coach being hauled up the Tyler Hill incline from Canterbury. This section of the line was worked by a stationary engine from 1830 to 1846. Since that date locomotives have worked through the tunnel. It was on this incline that I. K. Brunel spent some days making experimental runs in 1835 in order to convince the House of Lords' Committee on the Great Western Railway Bill that his own proposal for a line through the Box tunnel, where the incline is less than at Canterbury, was not the impracticable and dangerous scheme which it had been stated to be by his opponents.

Although the Canterbury and Whitstable Railway was not, until it was leased to and finally purchased by the South Eastern Railway, a financial success, it is of interest as being the first passenger railway in the south of England and also the first railway in any part of England to convey ordinary passengers in steam hauled trains. Many distinguished names, too, were associated with this railway. George Stephenson, Joseph Locke, John Dixon and Robert Stephenson all helped in its construction, while the plan and section of the line for which the Company's first Act was obtained in 1825 were set out by William James, whose claim to be the "Father of Railways" has been admitted by many who were well qualified to form an opinion.



THE CANTERBURY AND WHITSTABLE RAILWAY, FROM THE ENTRANCE OF THE TUNNEL NEAR CANTERBURY.

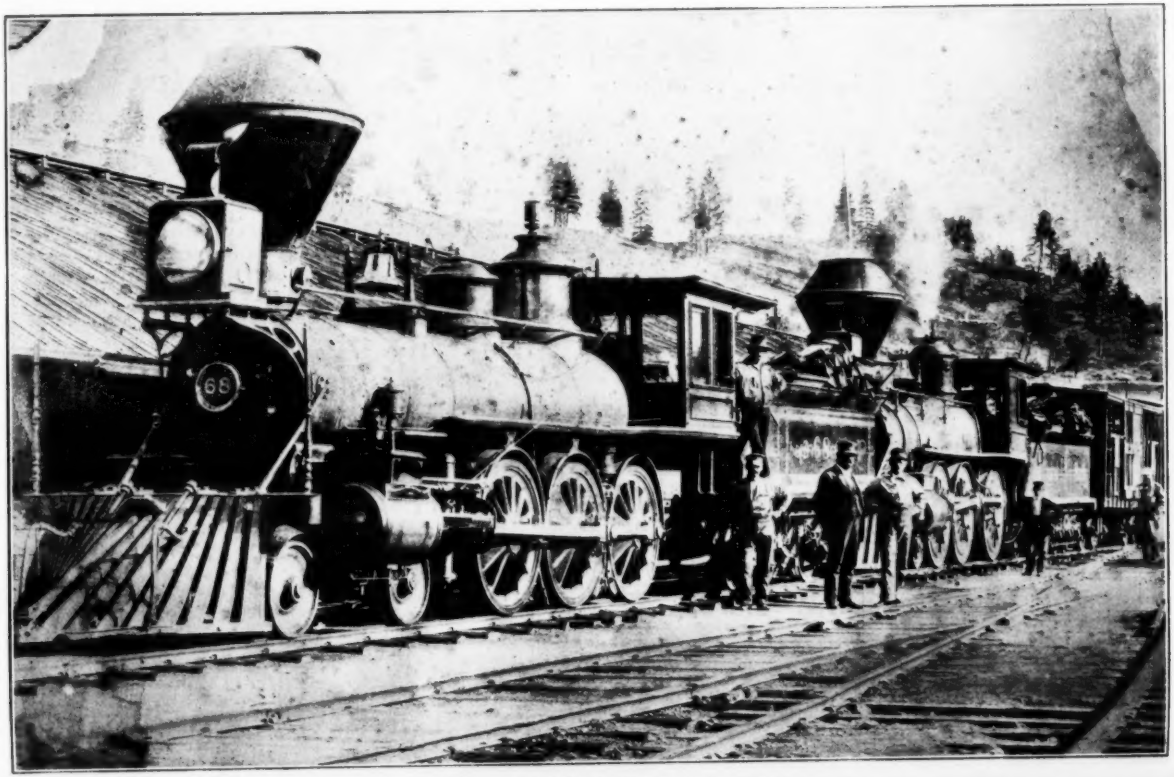


**CANTERBURY & WHITSTABLE RY.**

View of the Canterbury-Whitstable Railway from Church St., Whitstable, taken on the opening day, May 3rd, 1830.

CANTERBURY & WHITSTABLE RY.

View of the Canterbury-Whitstable Railway from Church St., Whitstable, taken on the opening day. May 3rd. 1830.




A VETERAN LOCOMOTIVE STILL ON THE JOB.

Central Pacific #68—"Pasquop"—McKay & Aldus—1868.

# *A Veteran Locomotive Still on the Job*

By D. L. Joslyn

IN 1868 the Central Pacific R. R. of California, received from the builders, (McKay and Aldus) at East Boston, locomotive No. 68 named "Peoquop", named for the Peoquop tribe of Indians. This locomotive arrived via Cape Horn and was brought to Sacramento on a river schooner and was placed in service on April 2nd 1868. It put in good work hauling supplies to Summit when the road was building and later was used in freight and passenger service across the Sierra Nevada mountains.

The locomotive with others of its class was in all branches of the service until 1891 when it was out of service for a time and was finally brought in the shop and rebuilt. The rebuilding consisted of the following; a new and larger boiler, new drivers 3″ larger in diameter, changing position of the drivers, shortening the wheel base from 21′ 5¼″ to 21′ 2¼″, new cylinders of the same size but bringing them down on a straight line in place of being on an angle, changing the cross head guides from 4 bar type to Laird type, applying new pistons and rods, new cross heads, applied air brakes of the push down type on the last two drivers, in other words the engine was brought right up to date for the period. After rebuilding it was given the same number as before, No. 68, but a short time later in 1891 the number was changed to 1536 and she had that number until 1901 when the number was changed to 2001, which number it still has.

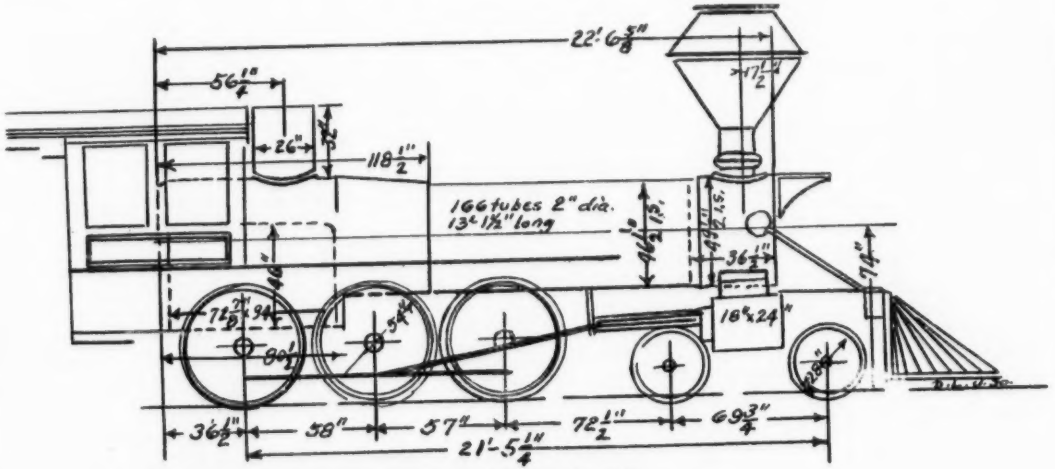
After rebuilding the engine was used for a number of years in freight service across the mountains running out of Rocklin to Wadsworth. Later it was used down the valley when the Co. got larger engines for the mountain service. I remember seeing the little old engine come across the Sacramento river bridge with a string of freight cars on several occasions. In later years the engine was sent to the Portland division and it worked on the Tilamook branch where our friend Herbert L. Arey used it for a while. It is now doing switching service at Dalles, Oregon but as the boiler is now old and is not worth renewing the little old engine is marked up to be dismantled.

At various times there have been added to the engine parts such as modern air brake equipment, electric head light, cast steel bumper beam, automatic coupler, metal pilot, steel cab, and other modern parts. As the engine now stands about all that still remains of the original locomotive is a part of the old frames. But even at that she is quite a veteran as there has not been a new boiler added since 1891 and that is quite a record. The boiler has been kept up to date by adding parts etc., and by repairs when needed.

One photograph shows the engine as it was in 1876 when it was hauling the overland train in company with No. 198. This picture was taken at Colfax, Calif. The man in the cab gang way was recently pen-



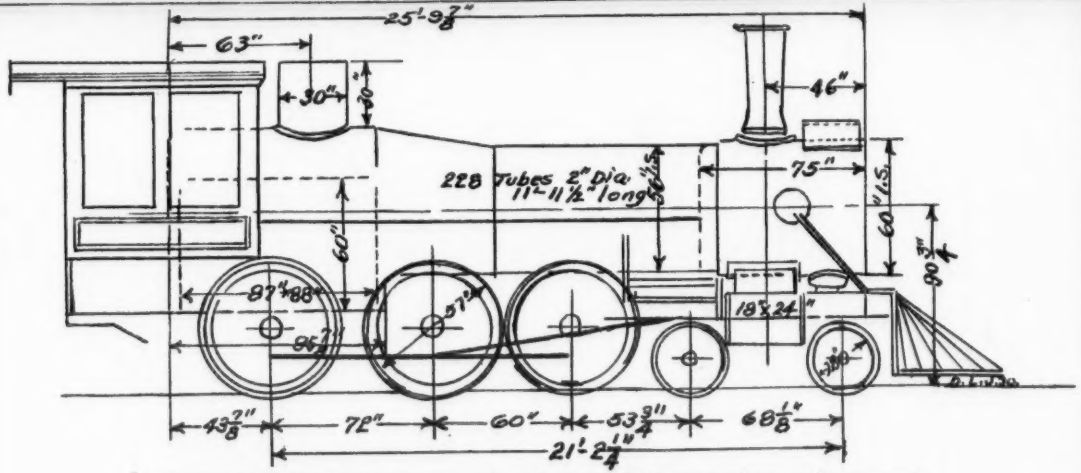
A VETERAN LOCOMOTIVE STILL ON THE JOB
Central Pacific #68—"Peoquop"—McKay & Aldus—1868.




C. P. 68, Built by McKay & Aldus 1868
Cylinders 18" Dia. x 24" Stroke, Drivers 54" Dia.

| | |
|---|---|
| Weight of engine loaded | 73800 lbs. |
| " on truck | 18500 lbs. |
| " " Drivers | 53300 lbs. |
| Grate Area | 17.21 Sq. Feet. |
| Heating surface of fire box | 85.1 Sq. Feet. |
| " " " Tubes | 1099.4 " " |
| " " " Total | 1184.5 " " |
| Boiler pressure | 130 lbs per Sq. inch |
| Tractive effort, 85% M.E.P. | 15840 lbs. |

Boiler pressure ____ 160 lbs.
Tractive effort, 85% M.E.P. ____ 15840 lbs.




C.P. 68 rebuilt Sacramento Shops 1891, number changed to 1536, 1891 and changed to 2001 in 1901.
Cylinders, 18" Dia. X 24" Stroke, Drivers 57" Dia.

| | |
|---|---|
| Weight of engine loaded | 113950 lbs. |
| " on truck | 18750 " |
| " " Drivers. | 95200 " |
| Grate area | 25.38 Sq. feet. |
| Heating surface, Fire Box | 129.4 " " |
| " " Tubes | 1417.6 " " |
| " " Total | 1547 " " |
| Boiler Pressure | 160 per Sq. inch |
| Tractive effort (85% M.E.P.) | 18550 lbs. |

sioned as Engineer. At the time the picture was taken he was fireman on the No. 68. The other picture was taken several years ago up in Oregon and shows the engine as it is today.

I have made two small diagrams of the engine as it appeared before rebuilding and as it appeared right after rebuilding. In these diagrams you can get a good idea of the engine before and after.

In the later picture of the old engine you will note that it looks quite modern. That is because the S. P. Co. makes it a point to keep all of their power modern as possible.

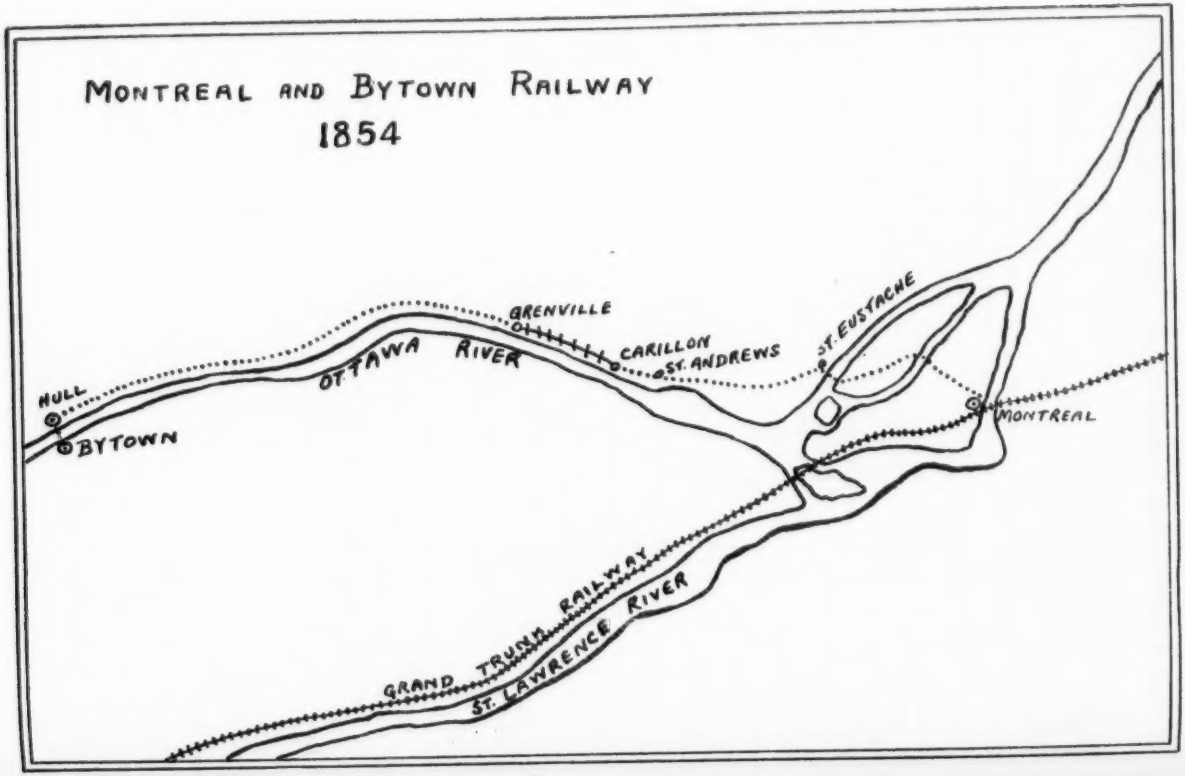
# *The Carillon and Grenville Railway*

By Robert R. Brown

BEFORE the advent of automobiles one of the favorite excursions for tourists and for the people of Montreal was a trip up the Ottawa River by boat. Midway between Montreal and Ottawa there is a series of rapids extending about 12 miles and as the canal there is very small and only suitable for small freight boats the large passenger steamers were unable to pass through. Boats were run from Montreal to Carillon, at the foot of the rapids, and from Grenville, at the head of the rapids, to Ottawa, and to carry the passengers past the rapids a curious old railway was used. The ride on the train was one of the principal attractions of the trip as the rolling stock, always a source of interest to travellers, was built during the fifties and probably was the last broad gauge train to run in America. While, in its later days, the Carillon and Grenville Railway was little more than a curiosity; originally it was intended to form part of an extensive group of railways, sometimes referred to in the newspapers at that time as the Great Montreal and Ottawa Valley Trunk Line.

A charter was obtained as early as 1848 but it was not until about the time the Grand Trunk Railway was organized in 1852 that any action was taken. A group of prominent Montrealers organized a number of companies to build a railway up the Ottawa Valley that would open up a new country and form a valuable feeder for the Grand Trunk. The Montreal and Bytown Railway was to extend from Montreal to Bytown, as the city of Ottawa was called until 1854, a distance of 119 miles and was to include two cheaply constructed branch lines, built with wood and strap iron rails, to Lachute and to St. Jerome. The Bytown and Pembroke Railway was to extend westward to Anprior, a distance of 35 miles, and eventually to Pembroke, about fifty miles more. The Brockville and Ottawa Railway was to extend southward from Bytown and connect with the Grand Trunk Railway at Brockville.

Contracts for the construction of the three railways were given to an English firm, Sikes, de Bergue and Co., and were under the personal supervision of Alexander Sikes. By the contract for the Montreal and Bytown Railway, the contractors were to receive for 110 miles of main line and 23 miles of branch tramway, the sum of £770,000 or about $3,850,000; and in the event of the work exceeding 2½% of the estimated lengths, then the contractors were to receive £6,500 ($32,500) per mile of excess on the main line, and £1,200 ($6,000) per mile for the extra length of tramway. Work was immediately commenced on the Montreal and Bytown Railway, the first and most important unit; surveys were made, a saw mill was erected at St. Andrews to supply lumber for the railway, and as the canal between Carillon and Grenville had been neglected and had become almost useless it was decided to rush the construction of the line between those points. The railway was to start from the Montreal Harbour near the foot of Jacques Cartier Square, then by a tunnel under Notre Dame Street to Craig Street, thence on the east of St. Denis Street to the height of land at Cote a Barron, and


MONTREAL AND BYTOWN RAILWAY
1854
GRENVILLE
CARILLON
ST. ANDREWS
ST. EUSTACHE
HULL
OTTAWA RIVER
BYTOWN
MONTREAL
GRAND TRUNK RAILWAY
ST. LAWRENCE RIVER

northerly to Riviere des Prairies, near Ahuntsic, then turning westward in the direction of St. Martin and St. Eustache. From the latter town the line was to pass through Belle Riviere and St. Andrews, touching the Ottawa River at Carillon, and following its north shore through Grenville, in a very direct line to the village of Hull, opposite Bytown. The first part of the line was to open up a rich farming country and also afford ample supplies of fire wood then so inordinately expensive in the city; the portion of the line beyond Grenville was to serve a lumbering country and it was hoped the railway would give Montreal a share of the export of deals to Europe, which was then monopolized by Quebec.

Mr. Sikes sent out his two brothers, William and Samuel, both skillful mechanics, and they set to work on the 13 miles between Carillon and Grenville; the part between Montreal and Carillon was let to subcontractors and work was started at several points. The old Provincial Standard Guage, 5′ 6″, was adopted, and the rails were U shaped iron bridge rails similar to those used on the Grand Trunk and Great Western Railways. Later on a few short sections were relaid with light modern steel rails.

The Carillon and Grenville section of the Montreal and Bytown Railway was soon completed; two locomotives and some cars were purchased and service was inaugurated October 25th 1854; the trains being run in connection with the steamers of the Ottawa Navigation Co.

The following year Alexander Sikes sailed for America for the purpose of inspecting the work but the ship, with all on board, was lost at sea and when the news became known in England the remaining partners decided to abandon the contracts. The Canadian directors of the railway company and the two Sikes brothers tried to raise the necessary capital in Canada but without much success and as the commercial depression following the Crimean War was just beginning the Company soon became bankrupt and the project came to an untimely end.

The 13 miles has cost $98,761, or about $7,745 per mile and on January 5th, 1858 Sir John Abbott, solicitor for the old Company, and a few associates bought the railway for £5,300 ($25,758) and operated the line for about five years.

About that time Ottawa was made the capital of Canada and as a consequence traffic on the Ottawa River increased enormously. The only railway running there was the Prescott and Bytown, noted principally for discomfort and poor service while the Ottawa Navigation Co. had put on new steamers that were famous for their speed, size and comfort. Traffic continued to increase and in 1863 the Navigation Co. found it necessary to purchase the railway; the name was then changed to Carillon and Grenville Railway and for many years it formed an interesting and important link in this chain of transportation.

About 1909 a new company was formed, the Central Railway of Canada, to carry out the original project of building a direct line from Montreal to Ottawa and the Ottawa Navigation Co., and the Carillon and Grenville Railway were taken over with that object but the following year the new company got into difficulties and the train service was

suspended. The line lay idle for four years, until the spring of 1914, when it was acquired by the Canadian Northern Railway to form part of their new transcontinental line. After a delay of several years a number of missing links were completed, the old railway was rebuilt to standard gauge and trains began running again in 1919. When the Canadian Northern bought the old line efforts were made to have the two 60 year old locomotives put in a museum but the railway did not realize the historical value of the two engines and they were sold to a junk dealer.

In 1854, when the railway was first opened two locomotives were bought; No. 1, called the "Carillon", was of uncertain origin as no contemporary record of it has been found. It was a 4-4-0 engine, about 28 tons, had outside horizontal cylinders, and an iron railing along each side and across the front. It resembled the Portlands of that period and there is reason to believe it was Portland locomotive No. 63 listed as having been built "for a Canadian road" about May 1854. It was broken up in 1895. No. 2, the "Grenville", was built by Kinmond Brothers of Montreal in September 1854; it was a small inside connected 4-4-0 engine similar to the Portlands, then the favorite make in Canada, except that it had an English type plate frame. About 1870, when traffic was very heavy, a third locomotive, the "Ottawa", was purchased from the Grand Trunk Railway. It was one of the fifty locomotives built by Peto, Brassey, Betts and Jackson at their Canada Works, Birkenhead, England, and shipped to Canada between 1854 and 1858. (Foot note:—See Mr. Loye's article on the Birkenheads in Bulletin 18) Its exact age is unknown, but the long wheel base of the leading truck and the comparatively attractive appearance would indicate that it was one of the later ones and probably was built about 1857 or 1858. The "Grenville" and the "Ottawa" remained in continuous service until 1910 and it is likely the "Grenville" holds the Canadian record for long service.

The following is a list of the locomotive stock of the Carillon and Grenville Railway, though in some cases the dates and dimensions are only approximately correct:

| | | | | | | |
|---|---|---|---|---|---|---|
| 1854 | No. 1 Carillon | 4-4-0 | 60" | 15x22 | 28 tons | Portland |
| 1854 | No. 2 Grenville | 4-4-0 | 60" | 14x21 | 22 tons | Kinmond |
| 1870 | No. 3 Ottawa | 4-4-0 | 60" | 16x20 | 25 tons | Birkenhead |

Traffic began to lessen about 1890 and the locomotive "Carillon" was scrapped in 1895. The "Ottawa" was acquired about 1870 but was then about twelve years old.

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*Bibliography*

History of the County of Argenteuil, R. Thomas
Report on the Montreal Northern Colonization Railway, 1872, C. Legge
Rapport du Commissaire des chemins de fer de la province de Quebec, 1881-2
Etat d'affaires des compagnies de canaux, chemins, chemins de fer, et de navigation, 1855.
An Historical Atlas of Canada, L. J. Burpee

Also considerable information was supplied by Dr. Albert E. Halsey, of Carillon, son of the late John Halsey, for many years the Superintendent, Master Mechanic and Engineer of the Carillon and Grenville Railway.

# *The Nova Scotia Railway 1854-1872*

By Robert R. Brown

DURING the first half of the nineteenth century Canada consisted only of parts of the present provinces of Ontario and Quebec while the three Maritime provinces, Nova Scotia, New Brunswick and Prince Edward Islands, were quite separate. During the winter months, when the St. Lawrence River was frozen over, the province of Canada was cut off almost entirely from the outside world and trade was practically suspended. Travelling within the province was comparatively simple but as far as the rest of the world was concerned travellers could make their way to New York by way of Lake Champlain only with the greatest difficulty and, for about five months, freight traffic ceased entirely except for occasional loads of fish brought in from the New England seaboard in large sleighs.

As early as 1832 it had been suggested that a railway from Quebec to the Bay of Fundy would relieve the upper province and also aid the development of the Maritime provinces and eventually lead to the union of all the separate provinces then known under the general name of British North America. In 1836 the St. Andrews and Quebec Railroad Company was incorporated, and the Imperial Government contributed £10,000 toward the cost of the survey which was made by Captain Yule of the Royal Engineers. The line was to run from St. Andrews, on the Bay of Fundy, north to Woodstock then westward through what is now northern Maine, but then considered Canadian territory, to Quebec. It was estimated the distance would be about 300 miles and the cost about One Million Pounds.

In 1842, before actual construction could be started, the Maine boundary dispute was settled, disastrously for Canada and the railway had to be postponed indefinitely.

In 1845, the year of the great railway mania in England, the project of an inter-colonial railway was revived but this time the line was to extend from Quebec to Halifax. During the next few years a dozen or more routes were surveyed and negotiations were carried on between the Imperial and the three Provincial governments but the disputes over the route were so heated that it soon became apparent that the possibility of joint action was remote so the three provinces, without any unity of plan, commenced the construction of their own sections of the line.

The Nova Scotia Railway was authorized by an Act of the Provincial Legislature on March 31st 1854 and the money was to be raised through the sale of provincial debentures in London by the English banking firm, Baring Brothers, who also helped finance the Grand Trunk Railway. On June 13th 1854, with the usual ceremonies, the first sod was turned at Richmond, in the north end of the city of Halifax, and construction of the first ten miles of the line was started. By the end of the year the line was completed to Four Mile House and cars were running to that point.

A locomotive, the "Mayflower", was built at East Bridgewater, Mass., by or under the direction of Elias Woodsworth, a native of Annapolis, N. S. When the locomotive was completed and shipped to Halifax in the fall of 1854 Woodsworth accompanied it and was given the position of Master Mechanic but unfortunately in December 1855 the "Mayflower" ran off the track, broke through the ice of Bedford Basin and Woodsworth was drowned. In addition to the "Mayflower", two small 4-2-0 ballast engines were ordered from Neilson & Co., of Glasgow, and they arrived at Halifax in the spring of 1855; they were named the "Sir Gaspard" and the "Joseph Howe" and the following year they were provided with cowcatchers and cabs.

Construction was pushed as rapidly as the slender resources of the province would permit and by the summer of 1857 the line was completed to Truro Road, now Lantz, 31 miles from Halifax and as several new locomotives had been received from Scotland regular service was inaugurated. According to the first time table trains left Halifax for Truro Road at 7:30 A. M. and 1:15 P. M. arrived there at 9:40 and 3:25 and left Truro Road at 10.15 A. M. and 4.15 P. M. and arrived at Halifax at 12.15 and 6.15 indicating a running time of 15 miles per hour.

When completed the line was to be in the shape of a large Y, the Main Line extending from Halifax to Truro, 62 miles, and a branch from Windsor Jct., to Windsor, 32 miles. Several large bridges delayed the completion of the line and it was not until the fall of 1858 that the railway was completed. Regular service to Truro was inaugurated on December 15th and about 500 people made the trip on the first train. It was feared that the village of Truro would not be able to feed so many in the two hours between arrival and departure but the ladies of the Methodist Church served dinner in the "meeting house" and all were satisfied.

As it was expected that the Nova Scotia Railway would connect eventually with the European and North American Railway in New Brunswick and with the Grand Trunk Railway in Canada the gauge adopted was the old Provincial Standard, 5′ 6″, also adopted by the other two lines. The cross ties were split half logs, 10 feet long, 10 inches wide and 5 inches thick, and spaced 2½ feet centres. The rails were double headed, 63 lbs. to the yard, supported in cast iron chairs spiked to the ties and the rails secured in the chairs by wooden keys. This type of superstructure was found to be rather unsatisfactory; the wooden keys were continually loosening and a great many of the cast iron chairs broke, especially in winter. Later on, rail of the present type were adopted but instead of using fish plates they were secured at the joints by steel scabbards; said to have been a very superior type of fastening though occasionally the scabbards slipped along the rail and allowed the joints to separate.

An extension from Truro to Pictou Landing, 50 miles, was opened for traffic on May 31st, 1867 and as this branch passed through the Pictou County coal fields coal was tried as fuel and was found to be much cheaper than wood so the locomotives were converted to coal burners.

The Nova Scotia Railway continued as a provincial venture until Confederation, July 1st, 1867, when it was transferred to the new Federal Government to form part of the proposed Intercolonial Railway; it continued running under its old name until November 1st, 1872 when the "missing link" between Truro and Painsec Jct., was completed and through trains were run from Halifax to Moncton and Saint John. In 1875, when the Northern Division of the Intercolonial was completed, the old acquired lines were altered from the old Provincial Standard Gauge, 5′ 6″, to the new Standard Gauge, 4′ 8½″.

The time table of 1866 gives some interesting details of the line under provincial management.

The Nova Scotia Railway at present connects Truro and Windsor and Halifax, N. S.

| | |
|---|---|
| Avard Longley | Chief Commissioner |
| T. Foot | Secretary |
| S. Fleming | Chief Engineer |
| C. Schrieber | Divisional Engineer |
| W. H. Tremaine | Divisional Engineer |
| George Taylor | Traffic Superintendent |
| W. Johnson | Locomotive Superintendent |
| W. Marshall | Road Inspector |

## Summer Arrangements

Trains leave Halifax for Truro at 6.00 A. M. and 3.30 P. M.
Trains leave Halifax for Windsor at 6.45 A. M. and 4.15 P. M.
Trains leave Truro for Halifax at 6.20 A. M. and 4.00 P. M.
Trains leave Windsor for Halifax at 6.45 A. M. and 4.50 P. M.

The morning train from Halifax connects at Truro with the stage coaches for Londonderry, Amherst, Sackville, Dorchester and Moncton and thence by rail for Shediac and Saint John and with the stage coaches of Hiram Hyde for Pictou and Point Brule and steamer thence to Prince Edward Island, Shediac, Miramichi, Bay Chaleur and Quebec and with Lindsay's line of stage coaches from New Glasgow to the gold fields and Canso, as well as Sydney and Arichat, and all points in Cape Breton. At Pictou, stages for River John, Wallace, Pugwash and Amherst connect daily. At Windsor the steamer Empress connects on Wednesdays and Saturdays for Saint John, N. B., and thence by railway to Shediac, or by the international steamer to Portland and Boston, and river steamers to Fredericton, Woodstock and Upper St. John. The stage of King Bros., also here connect to Annapolis, Digby, Yarmouth and all places in the Acadian Valley.

Passenger fares—First class, three cents a mile, second class, two cents a mile. Return tickets a fare and a half. Season tickets for three and six months at a reduced rate. Summer arrangements commence May 14th.

N. B.—The city horse cars connect with all trains at Richmond.

Fares were fairly low and so were the wages judging by present standards; engineers and conductors were paid ten shillings ($2.40) per day while firemen, brakemen and baggage men had to be content with five shillings though, no doubt, they considered themselves fairly well paid for those days.

The following is a list of the locomotive stock of the Nova Scotia Railway:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1854 | # 1 | Mayflower | 15x20 | 60″ | 4-4-0 | 22 tons | Woodsworth |
| 1855 | # 2 | Sir Gaspard | 12x18 | 60″ | 4-2-0 | 17 tons | Neilson |
| 1855 | # 3 | Joseph Howe | 12x18 | 60″ | 4-2-0 | 17 tons | Neilson |
| 1856 | # 4 | | 10x18 | 42″ | 0-4-0 | 10 tons | Neilson |
| 1856 | # 5 | | 10x18 | 42″ | 0-4-0 | 10 tons | Neilson |
| 1856 | # 6 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1856 | # 7 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1858 | # 8 | | 14x22 | 60″ | 4-4-0 | 22 tons | Portland |
| 1858 | # 9 | | 16x22 | 60″ | 4-4-0 | 28 tons | Portland |
| 1858 | # 10 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1858 | # 11 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1858 | # 12 | | 16x22 | 60″ | 4-4-0 | 28 tons | Portland |
| 1859 | # 13 | | 14x22 | 60″ | 4-4-0 | 22 tons | Portland |
| 1859 | # 14 | | 16x22 | 60″ | 4-4-0 | 28 tons | Portland |
| 1858 | # 15 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1858 | # 16 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1859 | # 17 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1859 | # 18 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1859 | # 19 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1859 | # 20 | | 16x21 | 60″ | 4-4-0 | 28 tons | Neilson |
| 1866 | # 21 | (Lost at sea) | | | 4-4-0 | | Kingston |
| 1866 | # 22 | | | | 4-4-0 | | Kingston |
| 1866 | # 23 | | | | 4-4-0 | | Kingston |
| 1869 | # 24 | | | | 4-4-0 | | Kingston |
| 1870 | # 25 | | | | 4-4-0 | | Kingston |

Numbers 2, 3, 4 and 5 were small ballasting locomotives and were never used for any other purpose; in 1869 the "Sir Gaspard" and the "Joseph Howe" were sold to the Windsor and Annapolis Railway then under construction. Details of the Kingston locomotives are lacking; they were built by the Canadian Engine Co., Kingston, Ontario; they were sent down to Portland over the Grand Trunk Railway and shipped from there to Halifax by boat. Number 21 was lost when the S. S. Equator sank in December 1866 shortly after leaving Portland.

The records of the Portland Co., show that six locomotives were built for the Nova Scotia Railway but the records of the railway show only five and there is nothing in the annual reports to explain this discrepancy.

About 1872 or 1873, after the line had become part of the Intercolonial Railway, a few locomotives were built in Halifax by a man named Montgomery but little is known about them and old engineers say that they were not very successful and did not last long.

When the gauge was altered in 1875 most of the old broad gauge locomotives were rebuilt and remained in service for many years. Three of the Kingstons, when rebuilt, were given to the Windsor and Annapolis Railway, now the Dominion Atlantic Railway, in exchange for some of their old broad gauge engines.

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*Bibliography*

Annual Reports of the Nova Scotia Railway Commissioners.
The Intercolonial—A History Sandford Fleming
Clarke's History of the Earliest Railways in Nova Scotia. The Halifax Herald.

# *Outline of the History of the Grand Trunk Railway of Canada*

By William H. Breithaupt, C. E.

WHILE much has been written on various features of Grand Trunk Railway history, a connected, continuous account of this, the largest and most comprehensive transportation systen in Canada up to the time of the development of that part of the country west of the Great Lakes, has not yet been given. The object of this paper is to present a general history of beginnings and development, both of which were complicated and involved, and to give some particulars of the engineering features.

For better understanding a brief reference to geography and to political history is in order. Canada, now practically the whole of British North America except Newfoundland, comprised, up to 1867, only the territory from Lake Superior to the Gulf of St. Lawrence, known first as Upper and Lower Canada. In 1841 Upper and Lower Canada were united into one province. In 1867 the federal union, the Dominion of Canada, was formed. At first it consisted of four provinces, Nova Scotia, New Brunswick, Quebec and Ontario, the two latter being the original Lower and Upper Canada respectively. In 1870 the mid-continent province of Manitoba; in 1871 the Pacific coast province of British Columbia; in 1873 the third maritime province of Prince Edward Island, and finally, in 1905, Saskatchewan and Alberta, on the great plains and partly including the Rocky Mountains, became provinces of the Dominion.

The first main transportation routes in Canada were waterways; the rivers and Great Lakes, from the far interior of the country to the seaports. Roads were at first portage routes between parts of the waterways. In like manner the first railway was a portage route between waterways. This was the Champlain and St. Lawrence Railway, later called the Montreal and Champlain Railway, from St. Lambert on the south bank of the St. Lawrence river, near Montreal, to Rouse's Point on Lake Champlain, opened in 1836. The track was of wooden longitudinal timbers on which were spiked flat bars of iron, and horses constituted the original motive power. The first steam locomotive came from England in 1837.

The Champlain and St. Lawrence Railway was at best a summer portage road; it was well over a decade after its advent that railroading proper began in Canada. In the neighboring United States the first section, 14 miles, of the Baltimore and Ohio Railway was open for traffic in 1830; the South Carolina Canal and Rail Road Company had 62 miles of railway open in 1832, in which year the Camden and Amboy, now part of the Pennsylvania Railway, was also opened for traffic; the Mohawk and Hudson and the Harlem Railway, later parts of the New York

Central and Hudson River R. R., date from 1830 and 1831; and the period 1831 to 1837 covers the beginning of various other railways in seaboard states. 1837 was a year of serious business crisis, after which railway building was materially checked in the United States for about ten years.

The initiative in Canada may be said to have come in what are still known as the Eastern Townships of Quebec on the New Hampshire and Vermont border, where an enterprising land agent and colonizer, A. T. Galt, later Sir Alexander Galt, was the moving spirit. Galt advocated a line from Montreal to the seaboard, with Boston first in view as the eastern terminus, but later displaced by Portland. Montreal, at the base of a great water transportation route, by rivers, canals and lakes, to the far interior, was indifferent until, in 1845, a bonding bill, permitting free passage through the United States of goods destined for Canada, was passed in Washington. This opened a route from New York and other United States ports direct to western Canada, and Montreal saw the need of connecting with the nearest winter seaport.

In 1845 the Canadian legislature incorporated Galt and his associates as the St. Lawrence and Atlantic Railway Company, with route for the railway from the St. Lawrence River opposite Montreal to the New Hampshire border, from which another road, the Atlantic and St. Lawrence Railway, chartered by Maine and New Hampshire, was to extend to Portland; the two projects forming a continuous line. Surveys for the St. Lawrence and Atlantic were begun in 1846, under A. C. Morton, as engineer. Funds were difficult to secure however, and it was not until December 1848 that the first section, 30 miles, from Longeuil opposite Montreal to St. Haycinthe, was completed. In 1852 it was opened to Sherbrooke and in 1853 to the provincial boundary. This was the first completed link of the later Grand Trunk Railway. C. S. Gzowski, later Sir Casimir Gzowski, a Polish exile, trained in military engineering, was chief engineer, 1848 to 1853, acting also as general manager from 1851 on.

Many railway projects were now under consideration. A chief object from the beginning was rail connection from Nova Scotia to Quebec and on to Montreal and the west. The final outcome of this was the Intercolonial Railway, Halifax to Quebec and later to Montreal. Another project called the European and North American Railway, was for a line from Halifax via St. John to Portland. The line from Halifax to Quebec was to be built by the three provinces, Nova Scotia, New Brunswick and Canada, while the Portland line was to be undertaken by New Brunswick alone.

The Ontario, Simcoe and Huron, later called the Northern Railway, and the Great Western Railway projects were the first in Upper Canada. By 1850 there were 55 miles of railway in all Canada.

In 1849 a general act, called the Guarantee Act, was passed by the government of Canada. This act enabled guaranteeing of interest on cost of any railway of a minimum length of 75 miles. The guarantee was, in 1858, extended to the paying of principal, a first lien to be taken on railways so aided.

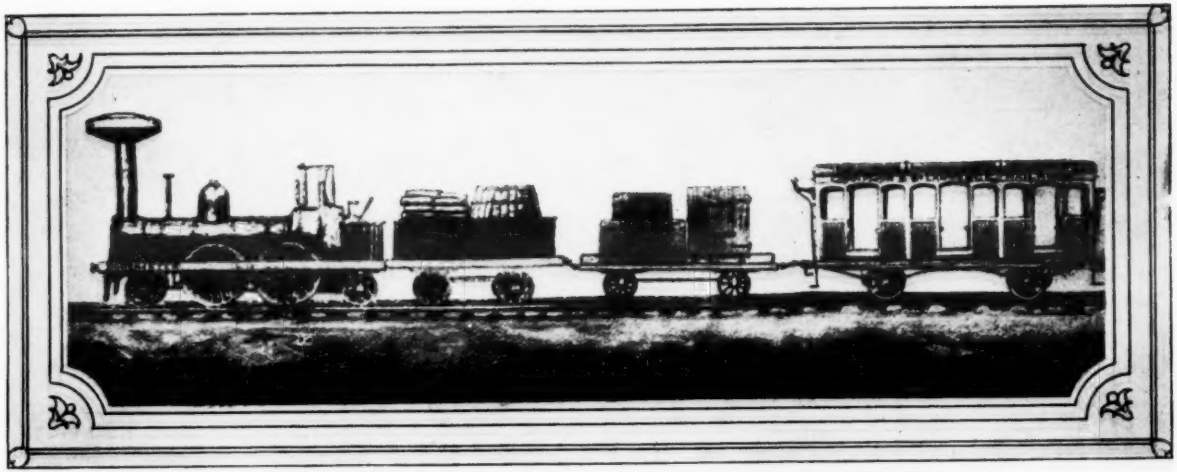

FIG. I. FIRST TRAIN WITH ENGINE, CHAMPLAIN & ST. LAWRENCE RY., 1837.

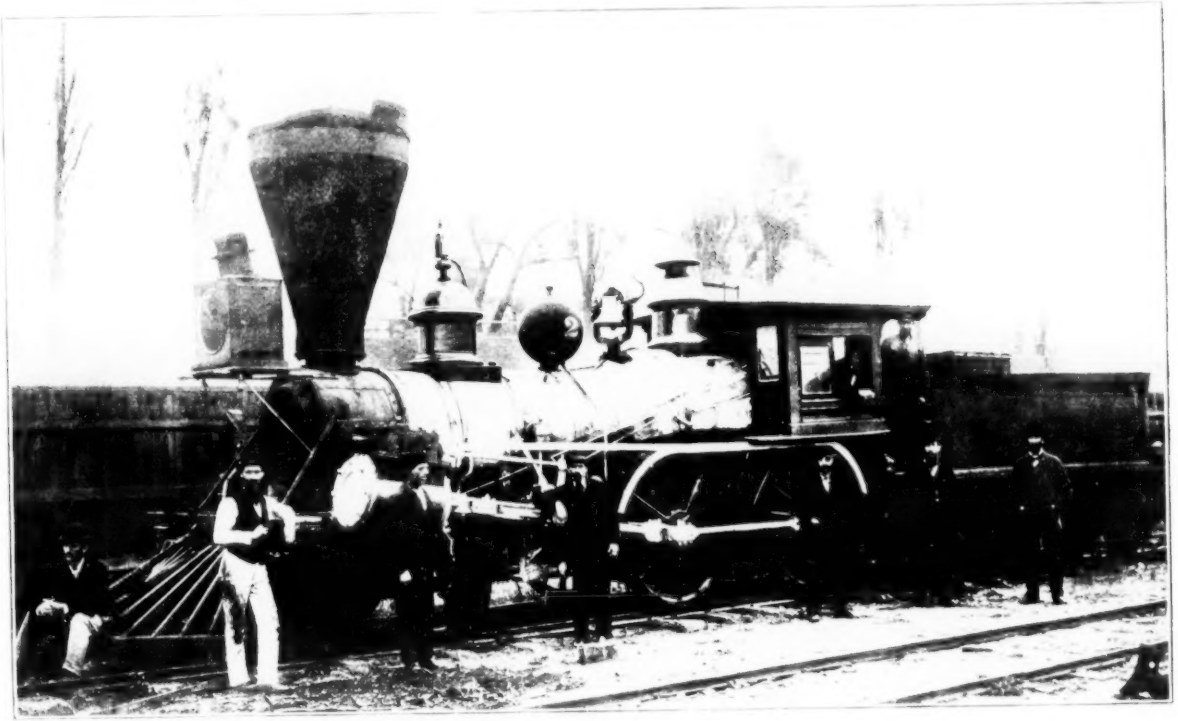

FIG. II. EARLY WOODBURNER ON NORTHERN RY.

Note: At the entrance of the Toronto Union Station, a bronze tablet of this locomotive, with the following inscription: "At this place on May 16 1853 the First Train in Ontario hauled by a steam locomotive started and ran to Aurora."

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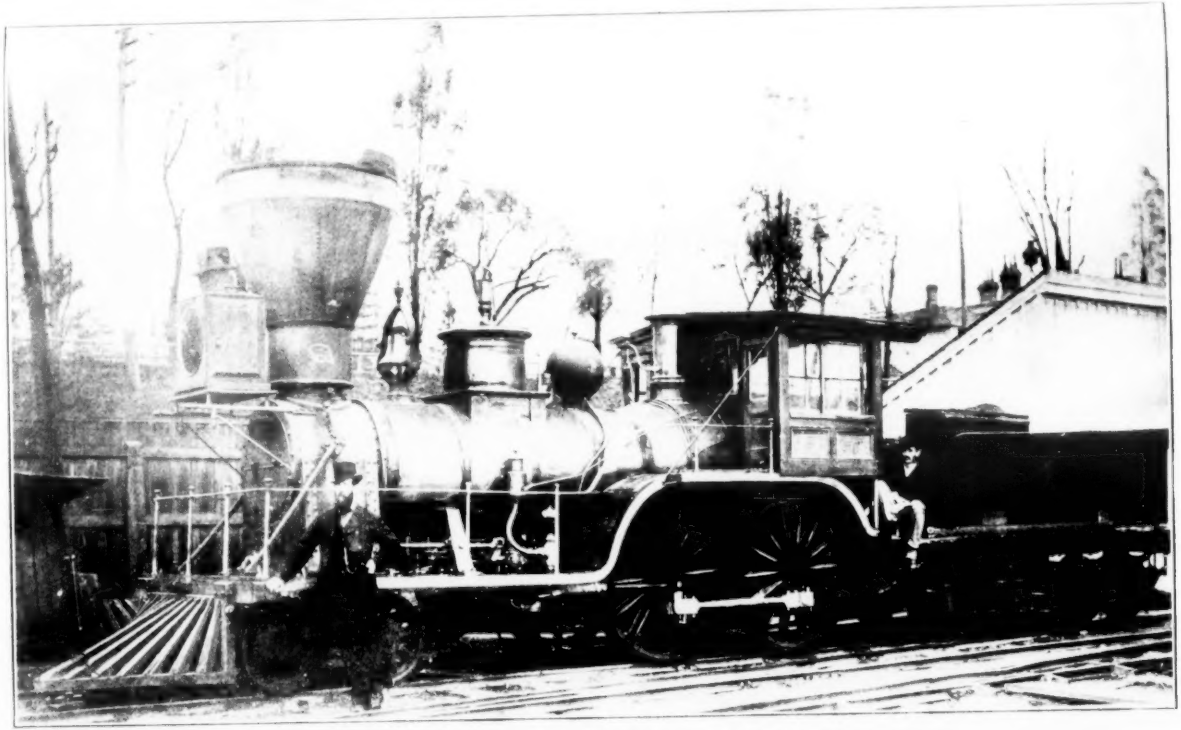

FIG. III. EARLY WOODBURNER ON GRAND TRUNK RY.

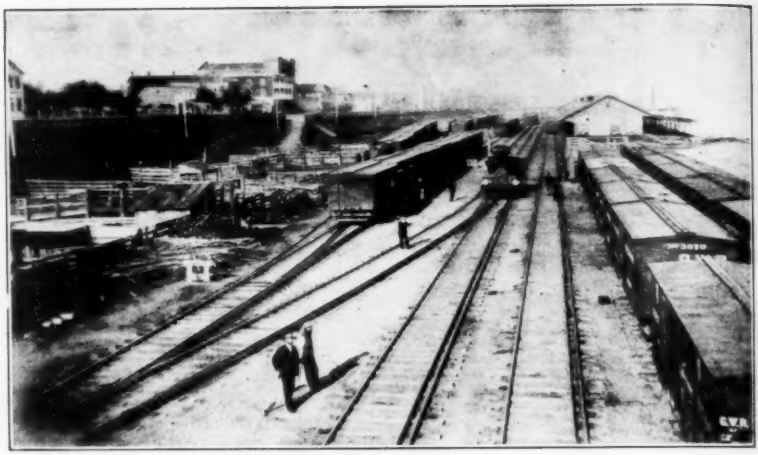

FIG. IV. GREAT WESTERN RY., WINDSOR, ABOUT 1865.

SOUTHERN PACIFIC LINES #2001.

At the inception of the Grand Trunk scheme the purpose, as already referred to, was to build a through railway from Halifax, traversing Nova Scotia and New Brunswick, and the length of Canada to its western boundary, the line to be owned by the three colonial governments, Nova Scotia, New Brunswick and Canada. To this end Joseph Howe of Nova Scotia went to England with a delegation, in 1850, and, after six months of persuasion, had a promise of guarantee from the British cabinet under which capital was to be forthcoming at 3¼ or 3½ per cent on bonds from the provinces. A line from Halifax to Portland was to be included with the general project. All three provinces readily agreed, in 1851, to build the railway jointly, whereupon the cabinet of England, for some unexplained reason, declared that there had been a mistake, and that it could not proceed with the guarantee.

Later William Jackson, partner in a firm of noted British railway contractors, appeared before the Parliament of Canada, applied for a new charter and exclusive rights for his company for a through line of railway, and eventually carried his point, as will appear. In New Brunswick he was partially successful, but Nova Scotia would have nothing to do with him. In the latter province the first railways were built as government works, with money borrowed from England, and honestly and efficiently carried out.

In 1851 an act "To make provision for the construction of a main line of railway throughout the whole length of the province" was passed by the legislature of Canada. A board of Railway Commissioners was created, consisting of the Receiver General, the Inspector General, and the Commissioner and Assistant Commissioner of Public Works. In the same year the Kingston and Montreal Railway Company was incorporated with a capital of £600,000. ($2,400,000). There was also a charter for a Kingston and Toronto Railway. Both of these charters were in control of A. T. Galt and associates, as was also the St. Lawrence and Atlantic with construction already well advanced. This would continue the line, on the east side of the St. Lawrence, from Montreal through Richmond to Portland, and the Quebec and Richmond Railway, (with charter owned by Quebec interests), would form the link between Richmond and Point Levis opposite Quebec.

A strong company of Canadian capitalists, consisting of John Young, Luther Holton and D. L. MacPherson of Montreal and A. T. Galt of Sherbrooke had the majority of stock subscribed and was ready to put through the entire line from Portland via Montreal to Toronto. Sir Francis Hincks, Inspector General in the government of Canada, however favored the English contractors Brassey, Peto, Betts and Jackson, who had become interested, considering them more dependable to be entrusted with so great an undertaking. This firm of railway builders had constructed about one-third of the railways of Britain as also railways in France, Germany, Spain, Italy and India. Thereupon, in 1852, a new act was passed, "To incorporate the Grand Trunk Railway of Canada" with capital of £3,000,000. with shares of £25., to build a railway over a designated route from Montreal to Toronto, with government guarantee

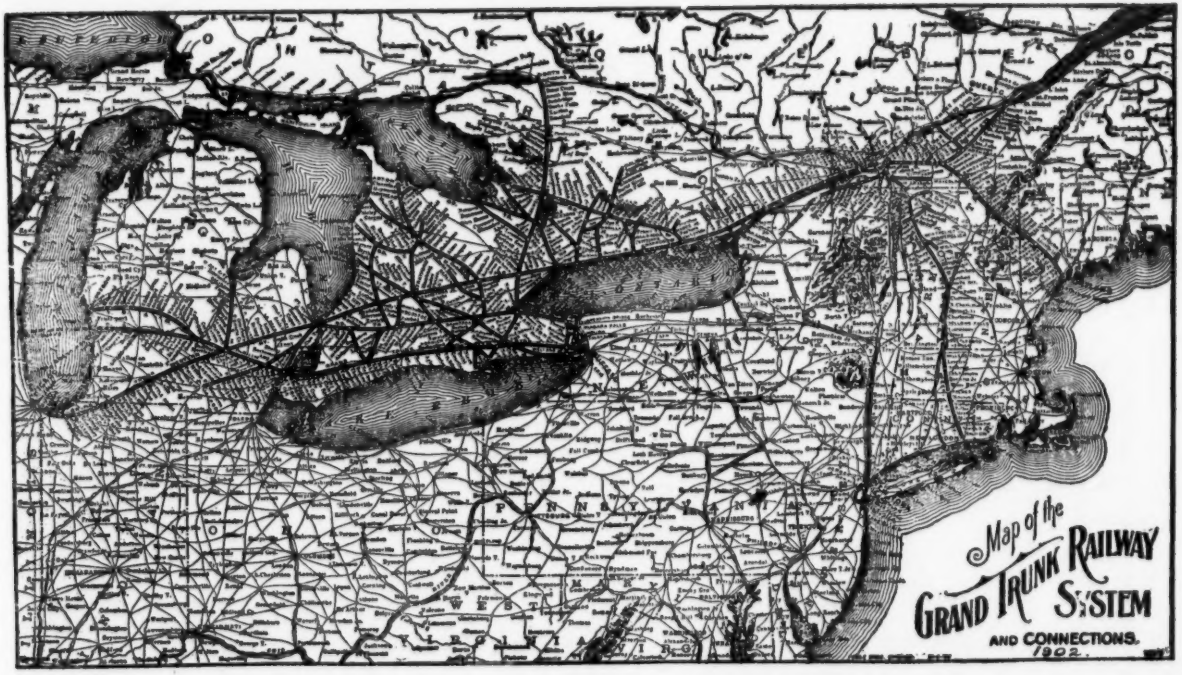


FIG. V.

of £3,000 ($12,000.) per mile. This charter marks the real beginning of railway building in Canada.

There were sundry other acts, and finally an amalgamation act, which repealed the Montreal and Kingston and Kingston and Toronto incorporations and enabled the Grand Trunk to absorb the various projects forming its main line from Portland, Maine, to Sarnia at the outlet of Lake Huron, and certain intersecting and tributary lines. From Toronto, westward, the first intention was to unite with the Great Western Railway, but negotiations failing, the route from Toronto via Guelph and Stratford to Sarnia, with a branch from St. Marys to London, was adopted. This tapping of Great Western Railway territory, especially at London, at once produced conflict, and the Grand Trunk and Great Western Railways were thenceforth rivals, until their amalgamation in 1882. The St. Lawrence and Atlantic section of the Montreal-Portland line was amalgamated with the main Grand Trunk, while the Atlantic and St. Lawrence was leased for 999 years on a basis of 6 per cent on the capital stock.

The English contractors now had complete control, and Galt and his associates could do nothing better than arrange with the dominant power. They secured fair consideration for their Montreal-Portland interests, and a valuable contract at the western end of the projected line. Management and control of this main trunk line, included in the cost of which and assumed by the shareholders were large expenses of promotion in the way of lobbying in Parliament and outlays incident thereto, in arranging with and paying costs of rival charter holders, and finally in unnecessarily costly construction, was thereafter, and for fifty odd years, vested in London away from and largely out of sympathy with local requirements, with lack of proper understanding and therefore inefficient management.

Negotiations were conducted in London in the first five months of 1853, and the Grand Trunk Railway Company of Canada was fairly started, with the support of English capital. The amalgamated company assumed the contracts, let in March 1853 and before, to the Brassey Company, for the line from Montreal to Toronto (334 miles) for £3,000,000 sterling; to the same company for construction of the Point Levis and Richmond line, 95 miles, for £650,000; for the Quebec and Trois Pistoles road, estimated at 153 miles, for £1,224,000; a contract for a bridge to cross the St. Lawrence at Montreal for £1,400,000; and also a contract to Gzowski, Holton, MacPherson and Galt for construction of the Toronto-Sarnia line, estimated at 172 miles, for £1,376,000.

The prospectus of the enterprise was issued in London while negotiations were under way under the guarantee of powerful local financial names and of seven members of the executive government of Canada. The capital stock was placed at £9,500,000. and profit was estimated at 11½ per cent. While the estimated gross receipts were later realized, the operating cost, estimated at 40 per cent, was 70 to 85 per cent, with no dividend available.

Construction was at once begun, and vigorously pushed. At one

time there were 14,000 men employed on railways in Upper Canada alone. In July 1853 the St. Lawrence and Atlantic section was completed; in 1854 the Quebec and Richmond section; in 1855 the main line was open to Brockville; in 1856 to Toronto and Stratford; in 1858 to London, and in 1859 to Sarnia. A line from Port Huron, opposite Sarnia, to Detroit, projected by individuals connected with the Grand Trunk directorate, was also opened in 1859. Early in 1860 this line was leased to the Grand Trunk for 999 years, on a basis of 8 per cent on an alleged cost of £450,000. The bridge at Montreal, named the Victoria Bridge, was begun in 1853 and regularly opened for traffic on December 19th, 1859. A short link, the Montreal and Lachine Railway, was opened for traffic in 1847—when it had an American locomotive which covered the 8 miles in 21 minutes—amalgamated with the Champlain and St. Lawrence in 1857, later leased, and finally, in 1872, sold to the Grand Trunk.

The first shareholders' meeting was called in Quebec July 27th, 1854, under Managing Director Sir C. P. Roney, Chief Engineer Alex M. Ross, and General Manager S. P. Bidder. The second annual shareholders' meeting was again in Quebec, September 5th, 1855. Subsequent annual meetings were regularly held in London.

The chief engineer's report, 1854, was, in part, as follows: Montreal-Toronto section, 333 miles: Land is purchased for 250 miles, also for Montreal station and for intermediate stations, about 3500 acres; for remaining 83 miles about 1000 acres are required; exorbitant prices are asked for land; at the crossing of Ottawa River outlet, St. Anne's to Vaudreuil, at southerly end of Montreal island, bridging is nearly 2200 feet, 949 men and 109 horses employed in construction, nearly all of the iron work, half the cost of the bridge, now completed in England and shipped; 7600 men and 1260 horses employed between Montreal and Toronto, of this 650 men and 62 horses on Montreal station, designed to meet future requirements for 1000 miles of railway. Toronto-Sarnia section: Toronto-Stratford, 89 miles, 1930 men employed; Walter Shanly resident engineer. Progress on Victoria Bridge. Quebec-Richmond section: Masonry throughout is superior a few iron bridges remain to be finished; passenger station and steamboat wharf advancing rapidly, delay in land purchase. Quebec-Trois Pistoles: Now located to Riviere du Loup; construction of first 40 miles to St. Thomas begun early in spring, one-third of grading is completed; masonry for large bridge is progressing; 1000 tons of rail received; 1142 men and 84 horses are now employed on this section. Montreal-Portland: Now in good running order throughout, trains are regular and reconstruction about completed; in 12 months ending July 1st, £275,000. was expended, one-third on road improvement, one-third on locomotives and cars, and remainder on payment of old debts.

The chief engineer's report September 1855 was: Montreal-Brockville; good construction, ready for operation in two months; Brockville-Belleville: 95 miles, masonry and station buildings to be completed this year, very little except laying and ballasting of track to be left for next

year; remaining 113 miles to Toronto, 40 miles at Toronto and heavy work well along, other part backward, along Toronto waterfront yet awaiting agreement with the city; Toronto-Stratford: work fast completing, Credit River bridge, largest west of Toronto, will require three months to complete, remaining work in full progress and of good quality; Stratford-St. Mary's: 12 miles well along, necessary to determine route to Sarnia; Quebec-Trois Pistoles: Work to St. Thomas, 40 miles, well forward, iron work for Etchemin bridge, 6 spans of 100 ft., lost at sea early in spring, replacement shipment daily expected, left England five weeks ago, opening of section will depend on completion of Etchemin bridge; Montreal-Portland: General progress reported, engine house and shops at Gorham burnt last January being rebuilt, one river bridge destroyed by spring floods for want of sufficient waterway, enlarged to double its former waterway, Berlin Falls branch graded, track laying to be completed, comment on absence of ocean steam communication with Portland.

The general manager reported scant business and general depression; that working expenses were a fraction over £11 per mile and that he hoped to reduce them to £10 per mile; that trains then running were capable of doubling actual receipts without material increase in cost, and that fares were reduced at opening of navigation, to compete with old established river and lake steamers, with good results.

An agreement dated January 21st, 1856, was concluded with the City of Toronto permitting Grand Trunk tracks along the waterfront to be proceeded with, on a width of 40 ft., and naming arbitrators, A. M. Ross and C. T. Keefer and a third to be named by them, to whom to submit any dispute. Article 17 of the agreement specifies that the city shall not require the Grand Trunk Railway to build bridges, ramps, crossings, etc., over or along the railway tracks, but shall provide all such.

With construction costs much greater than had been expected and business and returns far below anticipations, government interest charges defaulted, with the result that almost all the money advanced to railways under the Guarantee Act and the Grand Trunk advances finally became a gift rather than a loan. Francis Hincks' railway policy in total cost the government of Canada about $33,000,000. in principal and interest.

During the American Civil War both the Grand Trunk and the Great Western lost heavily through depreciated currency.

Between 1859 and 1867 the Grand Trunk built directly only 43 miles of railway. Its policy became one of acquiring existing lines and these will be taken up, each with a brief sketch of its history, in the order in which they were acquired. For clarity, and following the method adopted in the arbitration preliminary to taking over the Grand Trunk and other railways by the government of Canada, in 1921, the general course of events will be considered in ten year periods, from 1860 on.

## 1860-1870.

The Three Rivers branch, from Victoriaville and the Richmond-Quebec line to the east bank of the St. Lawrence opposite Three Rivers, and the Waterloo, Que., branches were built, together some 42 miles. The two lines of the Montreal and Champlain Railway, Montreal to the international boundary, were leased in 1864, and purchased in 1872; the Ottawa and Prescott line, sold under foreclosure, was purchased in 1861. This line was leased to the Canadian Pacific Railway Company in 1881 and sold to that company in 1882.

An agreement was entered into in December 1864 with the Buffalo and Lake Huron Railway for division of traffic receipts. In 1869 this developed into a lease of the Buffalo and Lake Huron by the Grand Trunk, and later to full incorporation with the Grand Trunk. This cross-peninsular line extends from Fort Erie, opposite Buffalo, at the outlet of Lake Erie, to the harbor of Goderich, on the east shore of Lake Huron. It crossed the Great Western Railway at Paris and the Grand Trunk at Stratford. It was opened, Fort Erie to Stratford in 1856 and through to Goderich in 1858.

Mr. C. J. Brydges became managing director, located in Montreal, in 1862.

At the close of this decade the Grand Trunk Railway system operated 1431 miles, 955 miles of which were directly constructed by the company, the balance leased or purchased.

## 1870-1880.

The International Bridge, crossing the Niagara River from Black Rock to Bridgeburg was opened in 1873. It replaced the ferry previously in use and gave the Grand Trunk unbroken connection to Buffalo.

The Chaudiere Junction to Riviere du Loup line, chartered in 1852, opened for traffic in 1855, 1857 and 1860, a subsidiary of the Grand Trunk Railway of Canada, was sold by that company to the Dominion Government in 1879, to form part of the Intercolonial Railway.

Mr. E. P. Hannaford first appears as chief engineer in 1873. In his report for that year he states that about 200 miles of track have been relaid, mostly with English steel; that much ballasting has been done, cost of ballast in track being 30 cts. per yard; that nine iron bridges have been erected east of Montreal, replacing wood; that on December 31st, sixteen wooden bridges above 50 ft. span remained on Montreal-Portland line; that extension, from Doon to Galt, 6 miles, of part of the former Preston-Berlin line was opened for traffic in October; that 221 steel rails had broken or cracked to date, but that steel rails gave much better permanency to track than the former iron rails. He also reports on change of gauge and gives full tabulated rail report, as will appear later.

The following year eleven more wooden bridges were replaced by iron on the Montreal-Portland line, and a branch from near Danville Junction to near Lewiston, Me., 5½ miles, was opened for passenger

traffic July 13th. The chief engineer also reports that steel rails, then in use for five years, some of them nine years, had worn evenly, and in proportion to tonnage carried, much better than iron rails which wore very unevenly; also that there was much trouble from broken freight car wheels.

The Grand Trunk, after years of effort and contention opened a line through to Chicago, in 1879. Before that time it had connection from Detroit to Chicago over the Michigan Central, but the acquisition of the latter railway by Vanderbilt, New York Central, interests, rendered this connection impracticable. The new line was made up of several smaller roads, previously constructed, control of the stock of which was acquired by the Grand Trunk, and of connecting sections directly built by the Grand Trunk. This became the Chicago and Grand Trunk Railway.

By 1880 the Grand Trunk operated 1705 miles of railway, with a through line from Portland on the sea to Chicago. Of this mileage, 895 miles had been built by the company and the balance acquired or leased.

## 1880-1890.

This was the greatest period of acquisition and leasing other lines. The entire Great Western system, the great rival of the Grand Trunk in southwestern Ontario and for western business from and to the United States, was amalgamated with the Grand Trunk in 1882. The Great Western system consisted of a main line from Suspension Bridge and Toronto to Windsor, with numerous branch lines: The Wellington, Grey and Bruce, extending from Harrisburg, (and including Harrisburg-Galt and Galt-Guelph original parts), through Guelph to Southampton, and to Kincardine, branching from Palmerston, on Lake Huron; the Sarnia branch from London to Sarnia and Petrolia; the London, Huron and Bruce from Hyde Park just west of London to Wingham; the Canada Air Line Railway from Glencoe on main line 80 miles east of Windsor almost in a straight line to the International Bridge; the London and Port Stanley Railway (leased); the Welland Railway, Fort Colborne on Lake Erie to Port Dalhousie on Lake Ontario, crossing the main line at Merriton; and the Harrisburg, Brantford, Tilsonburg and Port Burwell line, (leased).

A subsidiary line, the main western feeder for the Great Western, was the Detroit and Milwaukee Railway, Detroit to Grand Haven on Lake Michigan and thence connecting by three steamers owned by the company with Milwaukee.

A part of what became the Great Western Railway had charter, as the London and Gore Railway Company, as early as 1834. This charter was revived in 1845 as the Great Western Railway, authorizing a line from the Niagara River across the province to the Detroit River. In 1853, eight years later, the line was opened from the Niagara River to London, and in the following year to Windsor, opposite Detroit, with ferry connection. In March 1855 the Suspension Bridge across the Niagara River was opened for traffic, giving connection with the New

York Central Railway. The Toronto-Hamilton connection was opened for traffic December 3rd, 1855.

An early charter gave the Great Western and the Michigan Central authority to construct a tunnel under the river at Detroit. Considerable preliminary work was done under E. S. Chesborough, engineer, but the nature of the under river soil was then considered impracticable and the project abandoned. After acquisition of the Great Western the main traffic route from Toronto westward was changed to go via Hamilton and London to Sarnia instead of via Guelph-Stratford as before.

A line from Port Dover to Stratford was opened in 1876, extended from Stratford to Palmerston in 1877, and from Palmerston to Wiarton on Georgian Bay in 1881, with a branch from Palmerston to Durham built in 1881. The whole became the Georgian Bay and Lake Erie Railway in 1881, in which year the Grand Trunk obtained stock control and took over operation under lease.

The Midland Railway comprised a line from Port Hope on Lake Ontario to Midland on Georgian Bay, with a number of branches and connections. It was opened from Port Hope to Lindsay as the Port Hope, Lindsay and Beaverton Railway, (chartered in 1846), in 1858, and finally through to Midland in 1875. In 1878-79 a line was built through from Belleville, via Peterborough, joining the previous line at Lindsay. This, through to Orillia and Midland, became the main line. A line Toronto-Coboconck (originally the Toronto and Nipissing Railway, built to 3 ft. 6 inch gauge, 40 pound rail), crossing the main line to Lorneville Junction, was opened for traffic in 1872. Small branch lines were: Peterboro-Lakefield, Whitby-Port Perry, Cobourg-Marmora crossing the Belleville line, (the Cobourg to Peterboro part was later abandoned), Victoria Junction-Haliburton, Victoria Junction-Port McNicoll, and Stouffville-Jackson Point. All these lines and branches became the Midland Railway, total mileage 472. The Midland system was leased to the Grand Trunk in 1884 and consolidated with that company in 1893.

There were now, and until the end of 1895, four engineering departments: the Grand Trunk Division with E. P. Hannaford chief engineer; the Great Western Division, Joseph Hobson chief engineer; the Midland Division, J. G. Macklin chief engineer; and the Detroit District and Michigan Air Line, George Mason chief engineer.

The Ontario, Simcoe and Huron Railway, the name of which was changed to the Northern Railway in 1858, with main line, 94 miles, from Toronto to Collingwood on Georgian Bay, chartered in 1849, was built a little ahead of the Great Western Railway. It was opened to Barrie on Lake Simcoe in 1853, and to Collingwood in 1854. In 1875 a northern extension, Barrie, Orillia, Gravenhurst, was opened for traffic. In 1872 there was a short western extension, Collingwood to Meaford, which duly became part of the Northern. At the end of 1877, the Hamilton and Northwestern Railway, Hamilton to Allandale near Barrie, was opened for traffic, and a branch, Beeton to Collingwood, was opened in 1879. A southern extension of the Hamilton and Northwestern was the Hamilton and Lake Erie, Hamilton to Port Dover, chartered in 1863, built about

ten years later and opened for traffic in 1875. In 1879 the Hamilton and Northwestern joined with the Northern and the two became the Northern and Northwestern with F. W. Cumberland, successful manager of the Northern, general manager of the joint company. The North Simcoe Railway, Colwell, west of Allandale, to Penetang, opened in 1880, was operated under lease by the Northern & Northwestern. In 1886, an extension from Gravenhurst to Nipissing Junction on the Canadian Pacific Railway was opened for traffic, and became part of the Northern and Northwestern operating system.

The whole Northern and Northwestern Railway System was united with the Grand Trunk Railway in 1888. The old Northern and the extension northward became the North-Bay-Toronto connection for the Canadian Pacific Railway for about twenty years, and as such gave lucrative business to the Grand Trunk until that company reached westward, invading Canadian Pacific territory, when the latter railway built its own connection, in 1904-1905, from Sudbury to a point on its Toronto-Owen Sound line.

The North Shore Railway, Montreal to Quebec, built in 1879 and 1881, was purchased by the Grand Trunk in 1882 and sold by that company in 1885, under pressure of the Federal Government, to the Canadian Pacific Railway Company.

In 1888 there was traffic arrangement with the Atchison, Topeka and Santa Fe Railway, then just extended to Chicago and joint use with that railway of the Grand Trunk (Dearborn St.) station, Chicago.

In 1890 an agreement with the Toronto Belt Line Company was arrived at.

At the close of this ten year period the Grand Trunk operated 4,213 miles, an increase of 2,500 miles for the ten years. Of the total, 1,204 miles was built by the company and the balance purchased or leased. The increase for the ten years included the Toledo, Saginaw and Muskegon, and the Cincinnati, Saginaw and Mackinaw Railways in the United States.

## 1890-1900.

The St. Clair tunnel, under the St. Clair River from Sarnia, Ontario, to Port Huron, Michigan, giving direct rail connection in place of the former car ferry, was opened for traffic in September 1891.

A grand Trunk branch line, Glencoe-Kingscourt, was built in 1893, and another short connection, from Parkhead on the Wiarton line to Owen Sound, in 1895.

By a general amalgamation act in 1893 fourteen leased and subsidiary lines were amalgamated with the Grand Trunk, with no change in operated mileage. These, with mileage, were as follows:

| | | |
|---|---|---|
| The Jacques Cartier Union Ry. | 6.50 | miles |
| The Montreal & Champlain Jct. Ry. | 81.25 | " |
| The Beauharnois Jct. Ry | 19. | " |
| The Midland Railway | 479.25 | " |

| | | |
|---|---|---|
| The Peterboro and Chemong Lake Ry. | 9.18 | " |
| The Lake Simcoe Junction Ry. | 26.50 | " |
| The Grand Trunk Georgian Bay and Lake Erie Ry. | 189.75 | " |
| The London, Huron and Bruce Ry. | 68.88 | " |
| The Galt and Guelph Ry. | 15. | " |
| The Brantford, Norfolk and Port Burwell Ry. | 34.78 | " |
| The Wellington, Grey & Bruce Ry. | 168. | " |
| The Waterloo Junction Ry. | 12. | " |
| ((Waterloo to Elmira opened 1891. Berlin to Waterloo and Berlin to Galt, being extensions of part of old Preston-Berlin line, had been built by the Grand Trunk before.) | | |
| The North Simcoe Railway | 33. | " |
| The Cobourg, Blairton & Marmora Ry. & Mining Co. | 14.50 | " |
| **Total** | 1,157.59 | miles |

On January 1st, 1896, new impetus came to the Grand Trunk Railway in the appointment of Charles Melville Hays as general manager, succeeding L. J. Seargeant who went to London to act in an advisory capacity to the board of directors. On the same day Joseph Hobson became chief engineer of the entire Grand Trunk system east of Detroit. Mr. Hays came from the Wabash Railway where, as vice-president and general manager, he had shown exceptional ability. He at once proceeded with changes and improvements which had been for some time under discussion, notably physical improvement, replacement of the Niagara Suspension Bridge with a massive steel arch, and of the Victoria Bridge tubular superstructure by heavy, modern capacity trusses, etc., instituted an era of progress in general and became the dominant force on the Grand Trunk Railway, so remaining for the time he was connected with it.

In August 1897 the Niagara arch bridge was completed and in December of the following year trains began to use the double track of the new superstructure of the Victoria bridge, thereafter called the Victoria Jubilee Bridge.

In 1898, use of the Grand Trunk from Toronto to Hamilton, for non-stop through traffic, was given the Canadian Pacific Railway, on rental basis, which continues.

In 1900 the Chicago & Grand Trunk Ry., controlled by the Grand Trunk Railway of Canada was sold under foreclosure, incorporated under new title of Grand Trunk Western, and operated by a receiver for eleven months until December 1st, after that by the reorganized company.

Stock control of the Central Vermont Railway was secured by the Grand Trunk in 1899.

In 1900, 4,198 miles of railway were operated by the Grand Trunk, 1,238 miles built by the company and 2,960 miles acquired. The slight decrease from the last ten year period is due to expiration of lease of the London & Port Stanley (24 miles), abandonment of 46 miles in various sections, and addition of 54 miles in the Glencoe-Kingscourt and the Parkerhead-Owen Sound branches.

## 1900-1910.

In January 1901, Mr. Hayes left the Grand Trunk to become president of the Southern Pacific Railway. In the latter part of the same year he resigned this presidency, and returned to the Grand Trunk as second vice-president, and again general manager.

The Grand Trunk Pacific project, a transcontinental line, approved, notably on the judgment of General Manager Hays, by the Grand Trunk Railway of Canada shareholders at a special meeting in London in March 1904, was for a line of approximately 3,400 miles from Moncton in New Brunswick, through Quebec, Winnipeg in Manitoba, and Edmonton in Alberta, to Port Simpson, or near there, on the Pacific coast, utilizing in large part a route that had at first been intended for the Canadian Pacific, with crossing of the Rocky mountains at elevation much lower than any other transcontinental line, and in general with easier grades throughout.

The project was in two main divisions, the Eastern Division, Moncton to Winnipeg, 1,900 miles, to be built and owned by the Government of Canada and leased to the Grand Trunk, and the Western Division, Winnipeg to the Pacific coast, 1500 miles, to be built and owned by the company. The Eastern Division, Moncton to Winnipeg, was to be let to the Grand Trunk for fifty years; for the first seven years free of charge and for forty-three years at rent of three per cent on cost. The route almost due west from Quebec is one hundred to one hundred and fifty miles north of the Great Lakes with connections from the main line, one to North Bay and one to Fort William on Lake Superior, and well to the north of the Canadian Pacific main line in the West. From Montreal to Yokohama the route by the western terminus of the Grand Trunk Pacific is 500 miles shorter than the Canadian Pacific via Vancouver, and 1500 miles shorter than from New York to Yokohama via San Francisco. By 1906 construction was well under way on the long stretch between Edmonton and Winnipeg, and by July 1910 passenger service on this section, 796 miles, was in operation. The government section, from Winnipeg east, had also made fair progress.

An important acquisition of the Grand Trunk in this decade was the Canada Atlantic, 400 miles of main line from the Swanton, Vt., connection with the Vermont Central to Depot Harbour, and 63 miles of branches. The Coteau and Province Line Railway and Bridge Co. was chartered in 1872. Under this and other charters various sections were built, 1882 to 1885, from Coteau to Ottawa and southeasterly to the international boundary at Swanton, Vt., to form the Canada Atlantic Railway of which the Grand Trunk acquired control in 1905 and which was finally consolidated with the Grand Trunk in 1914. Two small extensions, Glen Robertson-Hawkesbury built in 1892, and South Indian-Rockland, built in 1896, were leased to the Canada Atlantic in 1899. In the same year the through line Ottawa-Arnprior-Parry Sound, (the terminus being Depot Harbor on Georgian Bay, near Parry Sound), with its branch Golden Lake-Pembroke, was amalgamated with the Cana-

da Atlantic. John R. Booth, lumberman and capitalist of Ottawa, who died December 1925, built most of the Ottawa-Parry Sound line, in 1895-1897. The Pembroke-Golden Lake branch was built two years later.

The Canada Atlantic was considered a material part of the eastern connecting system of the Grand Trunk Pacific scheme.

In 1904 there was built and brought into service a small connection, Lynden, on the old Great Western, to Brantford, 4.09 miles of new track, which changed the main line route to run through Brantford, slightly increasing mileage, instead of through Harrisburg as before. From Brantford to Paris the old Buffalo and Lake Huron, improved in grade and general construction, serves. The City of Brantford contributed a net bonus of $55,500 toward this change, to be on the main line west.

In 1907 Joseph Hobson resigned as chief engineer and retired from active work. He was succeeded by Howard G. Kelley. In the same year the Grand Trunk Pension Fund was instituted, beginning with a sum of £40,000.

. Many new passenger stations are mentioned as built, in annual reports, fifteen in 1906, seventeen in 1908, sixteen in 1909.

In 1909 Charles M. Hayes was elected President of the Grand Trunk and the Grand Trunk Pacific, etc., with office in Montreal, and Alfred W. Smithers became chairman of the Board of Directors in London. Presidents up to this time had been as follows:

1852-62 Hon. John Ross (Canadian)
1862-66 Sir E. W. Watkin, Bart.
1866-72 Richard Potter
1872-95 Sir Henry W. Tyler
1895-1909 Sir C. Rivers Wilson.

The Pontiac, Oxford & Northern in Michigan was purchased in 1909 as an addition to the Grand Trunk Western.

In 1910 the total operated mileage was 4,748; 1,227 miles built by the company and 3,521 miles acquired.

## 1910-1921.

In 1911 H. H. Safford succeeded Howard G. Kelley as chief engineer.

On April 15th, 1912, President Charles M. Hays lost his life through the foundering in mid-Atlantic of the White Star Steamship "Titanic". The death of Mr. Hays was an irreparable loss to the great railway enterprise of which he was the head. The Board of Directors, meeting in London May 3rd following, recorded their high appreciation of his great and exceptional services to the Grand Trunk and the Grand Trunk Pacific Railway Companies.

In Canadian Transportation history there appear three great railway administrators: Sir William Van Horne, builder and establisher of the Canadian Pacific Railway; Charles Melville Hays, President of the Grand Trunk Railway and of the Grand Trunk Pacific and Sir Henry Worth Thornton, President Canadian National Railways.

At the regular meeting of the Board of Directors, June 30th, 1912, Edson J. Chamberlain was elected president of the Grand Trunk and of the Grand Trunk Pacific. Mr. Chamberlain had been vice-president and general manager of the Grand Trunk Pacific since 1908. He retired September 1st, 1917 when Howard G. Kelley became president.

Heavy grade separation work was done in Toronto for several years, notably in 1911 and 1912. The new Union Station at Ottawa was occupied early in the year 1912 and completed in October of that year. On June 1st, the same year, the Grand Trunk hotel in Ottawa, the Chateau Laurier, was formally opened.

The Grand Trunk Pacific also built hotels; the Fort Garry in Winnipeg, the MacDonald in Edmonton and others.

In 1913 a short branch from Birch on the Penetang line to Midland was put in operation, and Midland soon became the chief lake terminus of this part of the Grand Trunk. In Michigan a line from Cass City to Bad Axe was built by the Grand Trunk Western and opened in 1913, and a line from Palmer, Mass., to Providence, R. I., was begun by the Vermont Central, but later work on this was suspended.

In 1918 the Grand Trunk Western and the Detroit, Grand Haven and Milwaukee Railways were taken over for operation by the government of the United States.

Many new stations were built during this decade, nineteen reported in 1911, including the large Guelph and Stratford stations, eighteen in 1912, twelve in 1913, twelve in 1915, six in 1916, seventeen in 1917, twelve in 1918 and fifteen in 1919.

In 1921, at the end of its separate corporate existence when it was merged with the Canadian National Railways under government ownership and operation, the Grand Trunk Railway of Canada operated approximately 4,781 miles of railway; 1,260 miles constructed by the company and 3,521 miles acquired.

Of the new transcontinental railway the name Grand Trunk Pacific came to be applied to the Western Division only, Winnipeg-Prince Rupert, built by the Grand Trunk, while the Eastern Division, Moncton-Quebec-Winnipeg was called the National Transcontinental. On both the Grand Trunk Pacific and the National Transcontinental construction steadily progressed. In 1911 track was laid on the continental summit, Yellow Head Pass. In the same year connection from the Transcontinental main line at Cochrane, to North Bay, over the Temiskaming & Northern Ontario Railway, a line owned and operated by the Province of Ontario, was made by agreement. This gave the desired direct connection from the west to Toronto. In the autumn of 1914 bi-weekly train service was established between Prince Rupert, the Pacific terminus, Edmonton and Winnipeg. The last spike in completion of the track, Winnipeg to Prince Rupert, had been driven April 7th, at Nechaco River crossing, 375 miles from Prince Rupert and 1,375 miles from Winnipeg. Grand Trunk Pacific branch lines to this date comprised a total of 1,059 miles. The chief engineer in charge of construction was B. B. Kelliher.

On November 18th, regular service between Levis, Quebec, and Moncton, N. B., began on the National Transcontinental line. The Quebec to Winnipeg part was also practically complete, but not yet operated. The gap remaining, Moncton-Winnipeg, was the Quebec bridge. Total cost, originally estimated at $61,415,000 had by this time reached $161,300,000. To this result scarcity of and large increase in the cost of labor largely contributed. There were also rock and other material classifications, differing from original specifications, by which contractors gained largely with result of added cost.

The Grand Trunk, in difficulty with the Grand Trunk Pacific, did not see its way to take over operation of the National Transcontinental part, of which the cost had been so greatly in excess of original estimates, and on which business, largely due to the war, was insufficient to pay operating costs, whereupon the Department of Railways took over administration. In 1915 train service between Superior Junction, near Winnipeg, and Quebec began on June 1st, and to Toronto by way of the Temiskaming and Northern Ontario Railway on July 15th.

Increasing difficulties, both on the Grand Trunk proper and the Grand Trunk Pacific, on which latter the operating deficit had risen to over $2,000,000 per annum, and fixed charges to $7,200,000, rendered it impossible for the Grand Trunk Railway of Canada to continue after 1919. Since early in 1918 negotiations for purchase of the railway by the government of Canada had been proceeding and now came an agreement, specifying arbitration to fix the sale price of common and preferred stock. Meanwhile a receiver was appointed for the Grand Trunk Pacific.

At the beginning of the Grand Trunk Pacific project, Mr. Hays had intended to build west from North Bay only. Under strong political pressure the project was extended eastward to Quebec and finally to Moncton. This much larger undertaking gave superfluous mileage, likely to be unremunerative for a long time. A serious curtailment of Grand Trunk Pacific business resulted from the invasion of its territory by both Canadian Pacific and Canadian Northern Railway branch lines, and this on financial support by the government, a breach of the original tentative guarantee as adjudged by the Grand Trunk. The untimely death of the original projector, Charles M. Hays, and later the Great War, were further great handicaps to the success of the Grand Trunk Pacific Railway.

Preceding the Grand Trunk Pacific undertaking there had been negotiations at various times, by Mr. Hays with the Canadian Northern, Mackenzie and Mann, railways, which had extensive lines in the west, culminating in an offer to sell out to the Grand Trunk at about $30,000 per mile. This offer the Grand Trunk directors declined, leaving no other course open but to build, if the vital western business was to be obtained.

The arbitration board, Sir Walter Cassels, Judge of the Exchequer Court, chairman; Sir Thomas White for the government; and Ex-President of the United States W. H. Taft for the Grand Trunk, finally

brought in their award in 1921, adjudging the common and preference stock of no value, with minority report by Ex-President Taft giving the value of the said stock as $48,000,000. Government ownership and operation of all Grand Trunk and Grand Trunk Pacific lines as also of the former Canadian Northern Railway, and the Intercolonial Railway etc. was complete in 1921, the organization being known as the Canadian National Railways, with total mileage 22,468, including the Central Vermont and other lines in the United States, 3328 locomotives and 137350 cars. In 1922 Sir Henry Worth Thornton formerly of the Pennsylvania Railway, later general manager of the Great Eastern Railway, England, in charge of railways in France during the war, and afterward Inspector General of transportation in England, was appointed Chairman and President, and so continues. The head office of the Canadian National Railways is the former head office of the Grand Trunk Railway, McGill Street, Montreal.

The original construction of the Grand Trunk main line was very substantial; materially better than general American construction of that day; modelled on the best English practice and so specified on the Montreal to Toronto part. West of Toronto, while reference to English standards was omitted in contracts, work was also most substantial throughout. Detail location of the line was left to the contractors, subject to the approval of the government engineer.

On the gauge of track there was much discussion. The question was between the general American standard, 4 ft. 8½ inch, the English so called narrow gauge, and the Brunel 7 ft. gauge. Weight of evidence was in favor of 4 ft. 8½ inch, while a gauge of 5 ft. 6 inch was adopted. Several engineers were consulted. T. C. Keefer cited authorities, including Robert Stephenson, in favor of the narrow gauge. A Royal Commission appointed in 1845 favored the narrow gauge. It was advocated by H. C. Seymour, state engineer of New York, as permitting connection with United States railways, while in other respects a wider gauge was preferable. John A. Roebling demonstrated the narrow gauge as safer for curves by reason of less slip of outer wheel and therefore less tendency to derailment; he recommended a gauge of 5 ft. 3 inch to 5 ft. 8 inch. A 5 ft. 6 inch gauge had already been adopted on the Portland-Montreal line. The Railway Committee of the Canadian Parliament finally, on July 31st, 1851, with all evidence before them, by a vote of 9 to 2 decided on the 5 ft. 6 inch gauge and this became the standard gauge of the Grand Trunk and of Canadian railways generally.

The Great Western Railway, which wanted the 4 ft. 8½ inch gauge for connection with railways at its New York State and Michigan ends, was virtually compelled by the government to a 5 ft. 6 inch gauge. It solved its difficulty by means of an inner rail giving additional gauge of 4 ft. 8½ inch.

In 1864 the Grand Trunk also laid a third rail to 4 ft. 8½ inch gauge from Sarnia to Stratford on its main line and continuing from there to Buffalo on the Buffalo and Lake Huron line. The Detroit-Port Huron line was built to 4 ft. 8½ inch gauge.

In 1872 the narrower gauge was made standard Sarnia to Buffalo, and also on the St. Marys-London branch. In 1873 the 4 ft. 8½ inch gauge was extended on all Grand Trunk lines west of Montreal. From Stratford to Montreal, 421 miles, and 60 miles of sidings, this was done on the 3rd and 4th of October, the work being completed in twenty hours and causing only sixteen hours interruption of traffic. In 1874 the narrowing of the gauge was carried out east of Montreal, mainly on the 25th and 26th of September, giving uniform gauge of 4 ft. 8½ inch over the whole line.

On the Great Western, as also on the Grand Trunk, Sarnia-Stratford-Buffalo, the adoption of the 4 ft. 6 inch gauge required only the taking up of one outer rail and the simplification of switches and intersections.

The first rail used was the English pear shape, soon followed by the inverted U-Section, (see fig. 2. pl. 2). English bullhead rails do not appear to have been used on the Grand Trunk at any time. Material was all wrought iron until 1862 when iron with steel face was tried, and not long used. The first all steel rail came in 1865. The Grand Trunk rail purchase record up to 1873 shows as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1850—60 | lb. | pear | shape | — | iron. | Chair joint | | |
| 1854—63 | " | "U" | " | — | " | Special chair joint | | |
| 1859—60 | " | "T" | rail | — | " | Fish plate joint | | |
| 1860—63.3 | " | " | " | — | " | " | " | " |
| 1860—65 | " | " | " | — | " | " | " | " |
| 1862—75 | " | " | "4 ½" | — | " | " | " | " |
| 1862—70.7 | " | " | " | — | " | with steel face. | | Fish plate joint. |
| 1865—63.5 | " | " | " | — | " | Fish plate joint | | |
| 1865— | " | " | " | — | steel. | " | " | " |
| 1867—75 | " | " | "4" | — | iron. | " | " | " |
| 1868—75 | " | " | "4 ⅞" | — | " | " | " | " |
| 1869—64 | " | " | " | — | steel. | " | " | " |
| 1869—77 | " | pear | shape | — | " | " | " | " |
| 1870—65 | " | "T" | rail | — | " | " | " | " |
| 1873—60 | " | " | " | — | " | " | " | " |

Rails in track December 31st, 1873, were reported by E. P. Hannaford, chief engineer as follows:

| District | Fish jointed steel rail T. | Fish jointed iron rail T. | U-Rail | T-Rail in chairs | Total Miles |
|---|---|---|---|---|---|
| Detroit | 15 | 44 | — | — | 59 |
| Western | 87 | 84 | 19 | — | 190 |
| Central | 269¾ | 63¼ | — | — | 333 |
| Buffalo-Goderich | 32 | 118 | — | 11 | 161 |
| Galt Branch | — | 7 | 6 | — | 13 |
| Champlain & Bonaventure Br. | 10 | 10 | — | 64 | 84 |
| Island Pond | 83½ | 60½ | — | — | 144 |
| Quebec-Richmond | 27¾ | 22 | 4 | 42¼ | 96 |
| Riviere du Loup | 1½ | — | 112½ | 4 | 118 |
| Athabasca | — | 5 | 12 | 18 | 35 |
| Portland | — | 150 | — | — | 150 |
| | 526½ | 563¾ | 153½ | 139¼ | 1383 |

As late as the end of 1886, the chief engineers report showed 113¼ miles of iron rails still in track.

The more modern sections were first arranged for between 1876 and 1880, purchases being largely 65 lb., and fitted with angle bar joints. In 1888 a 72 lb. G.T.R. design was purchased. It was revised during the two following years to a 78 lb. and 79 lb. section of which many miles are still in track.

About 1896 the 80 lb. Am. Soc. C.E. section was purchased. In 1900 a special 90 lb. rail with extra wide base was purchased for use on a section where soft foundation had given trouble.

In 1902 the first 100 lb. rail was purchased and used through the Sarnia tunnel.

In 1904 the first purchase of 100 lb. Am. Soc. C.E. section was made and purchases continued until 1914.

In 1914 a quantity of 90 lb. Am. Ry. Assoc'n. -A- section was purchased for use on some of the more important branch lines and in this same year 100 lb. ARA-A was first purchased. This section is still the main line standard.

During 1915-16-17, when Canadian steel mills were under special government control on account of war conditions the only rail rolled was 85 lb. Can. Pacific Ry. section, and it was used during that period by all Canadian railways requiring rail.

Increase of business required double tracking, first on the line between Montreal and Toronto. By September 1890, 170¾ miles of this was completed, and in 1891 it was extended to 203¼ miles. In the next following years not much was done. In 1899 the only single track remaining between Montreal and Toronto was 46¼ miles between Port Hope and Port Union. In 1903 double track Montreal-Toronto is reported as finished, and also that it extends to Niagara, giving continuous double track from Montreal to the Niagara River. In the same year double tracking was completed, all but a few miles, Port Huron to Chicago, on the Grand Trunk Western. In 1904 double track is reported almost completed west of Hamilton, leaving only 50 miles of single track between Hamilton and Sarnia. In 1907 double track between St. Lambert and Victoria Bridge is reported as used jointly by the Grand Trunk and the Intercolonial. In 1909 double track extended eastward to St. Rosalie Station, 38.01 miles from Victoria Bridge. Finally in 1917 double track was completed, St. Rosalie to Chicago and to the Niagara River except for the single track St. Clair tunnel and about five miles in Indiana.

Engines for the Grand Trunk were first built at the Canada Works, Birkenhead, England, and later at the Point St. Charles shops, at Montreal. Weight of the early engines, 1853, was in the vicinity of 25 tons. This increased from time to time, in common with engine weights on American railways until in 1904 a weight of 104 tons is noted. Engine weights can be followed from the Grand Trunk bridge specifications. In 1892 the Cooper E.40 loading was used, and this engine weight continued until increased in 1900 to E.45 basis. In 1907 the newly issued Am. Ry. Engineering Assocn. specification with Cooper E.50 loading was

adopted, revised in 1910 to E.50 and E.60 basis, which practically continues.

Wood burning locomotives, with large stacks for spark arresters, were used altogether on Canadian railways up to about 1873 in which year the first coal burning engine, changed from wood burning in the shops at Stratford, was put into service. The change from wood to coal burning took several years and was coincident with altering, or scrapping and replacing, for change of gauge. During the wood burning period, about twenty years, enormous quantities of the finest hardwoods were consumed, the heaviest forestations on the old main line being between Toronto and Sarnia. The railway thus afforded a ready market for the produce of the settlers clearing operations. At Stratford in a record year 16436 cords of wood were issued. This represents a compact pile of cord wood 40 ft. wide, 20 ft. high and almost exactly half a mile long.

Of the five crossings of the St. Lawrence waterway, in order of location from downstream, the Victoria Bridge at Montreal, the Coteau Bridge on the Swanton, Vt.-Ottawa line, the Suspension Bridge below Niagara Falls, the International Bridge at Buffalo and the St. Clair Tunnel at the outlet of Lake Huron, all built by or for the use of the original Grand Trunk Railway or its constituent parts, the two first being wholly in Canada and the latter three crossing the international boundary line, the first to be put in service was the Suspension Bridge, and this was in 1855, for the Great Western Railway.

This bridge was built and owned by an independent company for whom John A. Roebling, the great pioneer in and later proponent of the art of suspension bridge building, was engineer. It was the first, and so far only suspension bridge built to carry a full main line railway load.

The place of location of the Suspension Bridge, about two miles below Niagara Falls, was, on the New York side, called Suspension Bridge and this name continues although the old bridge disappeared almost thirty years ago. This bridge spanned the gorge of the river, here about 210 ft. deep. It had an upper single track railway deck and 17 ft. below this a carriage way of 19 ft. width between posts. A continuous truss 820 ft. long, with posts spaced 5 ft. longitudinally, rod braced, and having wooden floors both for the railway above and for the enclosed roadway below, extended the length of the span, and was carried by four cables, two on each side, supported on solid masonry towers. Each cable was composed of seven strands of 520 scant No. 9 wires, a total of 3,640 wires, each individual wire continuous, ends being carefully spliced throughout the length of the cable. The cables were in two pairs, upper and lower, the upper pair having a versed sine of 54 ft. and the lower 64 ft. To aid lateral stability they were hung in inclined planes, converging inward from the towers. The towers, built of limestone quarried near the site of the bridge, were in shape truncated cones, were 90 ft. high on the New York side and 80 ft. on the Canada side where the rock was 10 ft. higher. The top of each tower was covered with a cast iron plate on which rested rollers supporting the cast iron saddle carrying the cables.

The Suspension Bridge served for 42 years, from 1855 to 1897, and in latter years far beyond its original intended capacity of loading. In 1880 the wooden stiffening truss was replaced by a steel truss and in 1886 the disentegrating masonry towers were replaced by towers each made up of four wrought iron braced columns, both changes being made under direction of L. L. Buck, M. Am. Soc. C. E. as engineer.

Finally increasing traffic and heavy loading imperatively called for an entire new structure, for which Mr. L. L. Buck designed the massive double track arch still in use. This was taken in hand early in 1896 and opened for traffic in July 1897.

The Niagara Railway arch has span of 550 ft. between centres of end bearings, is of braced spandrel, three hinge design with 115 ft. trusses, one at each end, to bank abutments. It carries two modern capacity railway tracks on top and a roadway with trolley tracks below.

The full history of the Suspension bridge and its replacement by the arch bridge is given in the Transactions of the American Society of Civil Engineers. (Vol. XVII 1887 and Vol. XL 1898.)

## THE VICTORIA BRIDGE.

From the beginning of the Grand Trunk Railway project it was evident that a bridge across the St. Lawrence River was a necessity, and that this bridge should be at or near Montreal. The Railway was incomplete confined to the North Shore. From the head of Lake Superior to the Atlantic Ocean there was no bridge over the river except at the Niagara Gorge.

As early as 1846 the Hon. John Young of Montreal suggested the practicability and necessity of a railway bridge near Montreal. There were successive reports from engineers: Morton in 1846, Gay in 1847, Gzowski in 1849, and T. C. Keefer. On these reports and on information obtained at the site, A. M. Ross, on his return to England, designed the bridge, on the tubular girder plan on which it was built; as chief engineer of the Grand Trunk Railway he afterwards resided in Canada until the bridge was completed.

The great importance of the project and large cost involved decided the Grand Trunk Railway directors to consult Robert Stephenson, builder of the Menai Straits tubular bridge. Stephenson approved Ross' plans and joined as engineer.

In the summer of 1853 Stephenson visited Canada to personally examine the bridge site, deciding conjointly with Mr. Ross on location, the down stream end of the La Prairie basin at the west end of Montreal harbor. The opening, shore to shore is 8660 ft. The water is shallow, and full of boulders. Mid shoals divide the riverbed into two channels, causing great difficulty in delivery of construction material by boat, having to pass down one channel about a mile, and up the other against a current of 7 to 8 miles an hour. The bottom is solid rock for about 1900 ft. out from the north shore and 600 ft. from the south shore, free from deposit excepting the large boulders. Toward the centre there is

shale, clay and quicksand overlaid by a kind of hard pan, 12 to 14 ft. thick.

The most serious difficulty in construction was the ice. Before the final freezing up of the river there is what is called shoving, a final movement of the ice, before solidification. In the spring before break up there is another shove or movement of the whole mass. Anchor ice, called frazil, forming in the swift current, in elongated, stringy particles, denser than surface ice, is liable to collect in large masses.

The piers were designed with long toes upstream, with inclined, wedge caps, against which large floes slide up with the swift current and break. This style of pier was generally used, even for smaller rivers, in the old Grand Trunk bridges. At the Vaudreuil Bridge spanning the outlet of the Ottawa into the St. Lawrence river, six piers on an island, only flooded during very high water, were not provided with ice breaker toes. In 1855 the river rose high; ice of the lake of the Two Mountains, not far above, came down in a mass, and slowly moved the upper parts of the piers 2 ft. downstream. The piers were rebuilt with ice breaker toes.

For the Victoria Bridge there are 24 piers and the north and south abutment. On these rested the 25 spans of the bridge, 24 of 242 to 247 ft. span, and a centre span of 330 ft. Piers are numbered from the north shore.

Suitable stone for piers was found at Caughnawaga, on the south shore, not far from the bridge, on land belonging to the Indians, from whom it was purchased. Quarries were also opened at Point Claire, north shore, 16 miles west of the bridge. The stone was at first all brought down on the river; by barges and paddlewheel tugs, later by Grand Trunk railway line passing near the quarry. It is hard limestone, black in fracture, light grey when tooled and after exposure to the weather for a number of years. Depth of water at the bridge site was found to be 5 to 15 ft. at summer level. The limestone riverbed with large boulders suggested the expedient of floating cofferdams, which could be constructed on shore in winter season and later launched and floated to place. These cofferdams 188 by 90 ft. in out to out horizontal dimensions and 12 to 16 ft. deep had double walls and were framed of heavy timber (See pl. 1). The downstream end was detachable so that after completion of a pier the cofferdam could again be floated and towed to a place of safety for use next season. The draft, when floating was about 18 inches, but even this light draft did not always clear the boulders. At spacing of 20 ft., along the walls of the cofferdam caisson, spuds, moving in grooves slid to the bottom of the river, for anchorage. Ten or twelve of these spuds in each caisson were centre bored and had 2″ iron bars inserted, and drilled into the rock of the river bottom. The caissons were then scuttled and sunk to place, generally first resting on boulders, which had to be removed with much difficulty. The two walls of the caisson, with bracing between them, gave stability. The 4 ft. puddle chamber was formed by 3 in. sheet piling along the inner wall of the caisson and 4 ft. within this, 6 in. sheet piling driven along waling pieces held in place

FIG. VII.




FIG. VIII.

by iron brackets projecting from the caisson wall, all sheet piling being driven down to river bottom (See pl. 2). Cofferdams for the north abutment were formed in the same manner. There were six caissons, each 20 by 150 ft., two on each side and two across ends. They were constructed on the bank of the Lachine Canal and were ready for launching early in May.

Early in 1854, the ice having formed, the position of piers was marked on the surface and soundings taken with rods through holes cut in the ice. Some of these soundings were erroneous on account of the swift current and anchor ice. The deepest sounding was 18 ft., at Pier 13. At the centre of each pier location an iron pin, 5 ft. long and 4 inches in diameter, was bored into the bed of the river 3½ to 4 ft. A level road was made along the centre line of the bridge over the rough ice.

The men brought from England suffered severely with the rigorous climate. The hard pan toward centre of the river was first taken for continuation of the rock bottom, and later gave much trouble in sinking piers through it and the underlying sand and clay to bed rock.

Crib work of heavy timbers filled with stone, a colonial device then new to the English engineers, was framed on the ice. Anchor cribs, upstream from position of piers, were thus formed, and sunk through the ice, to serve for holding of cofferdams, etc.

The first caisson 150 by 20 ft. for the north abutment was towed upstream from the Lachine Canal May 24, 1854. This was practically the beginning of the work on the bridge.

It was soon found impossible to moor this caisson broadside against the current. The end caissons, parallel to the current, were then first moored, after which a line of stone filled cribs was sunk just above position of the side caisson. The cribs supported timber beams carrying one end of an incline apron of timbers with upstream end on the river bottom. This gave quieter water and allowed placing of the longitudinal caisson for the abutment cofferdam.

By August 28th., 1854 the cofferdams were pumped out and masonry was begun. The stone, brought down through the Lachine Canal, was trucked from the canal basin. 85428 cub. ft. of stone was laid during the summer, bringing the abutment to about 4 ft. above summer water level. The embankment approached to about 5 ft. above water level, but connection between it and the abutment was not completed when work ceased in the fall; in consequence a large part of the embankment was washed away by the spring high water.

The caisson for Pier 1 cofferdam was in place June 14th. Two months later the masonry was above water level, but was not finished until late in November, too late by a few days for removal of the dam caisson.

For Pier 2 the caisson was in place early in July. It was struck by a large timber raft, carried downstream, anchored and brought back to position.

Other delays prevented pumping until Sept. 18th. A large leak, due to a fissure in the rock, could not be stopped, so that pumps were kept going until masonry was above water level.

On account of extreme difficulty in floating the large cofferdam caisson to place it was decided to construct the dams for Piers 5 and 6 of cribwork. To build the cribs on shore and tow them out was found to be impracticable. Then cribs were built in the lake above and floated down but could not be held in place. Finally a crib was built just below the mooring crib and sunk to place. From this other cribs were built until the dam, by this slow and costly process, was completed.

The first working season at the bridge was a period of great difficulty. There was great demand for labor in western states, repeated strikes —in one instance a party of mechanics brought from England at a cost of $3000. All struck and left within a fortnight—and finally cholera broke out, and did not abate until September, after which work was more satisfactory. Work had to be stopped, with severe weather, the first week in December.

The cofferdam for the south abutment was constructed of cribs, work beginning about middle of May, 1855. Water along the shore was shallow and the current 2 miles an hour. Material was taken out on a tramway built on cribs. The dam was completed and pumped out by end of July, the ground excavated 8 ft. to sound, hard bottom. Masonry was begun end of August, and by close of season was 2½ ft. above water level. Stone for the south abutment and several south piers was brought from La Motte Island in Lake Champlain. It was taken in barges 40 miles to St. John thence by Champlain railway to site. This stone had smoother fracture, otherwise differed little from that of Point Claire. A steam traveller, 60 ft. span on longitudinal tracks 1300 ft. long, handled and sorted all stone on the south shore.

The emigrant mechanics as also the men in charge greatly improved on their native capacity. Expensive travellers built in England would not work, while subcontractors from England roughly built the one used, which worked well. During the winter of 1854-55 cribwork for Pier 6 dam was built on the ice and sunk to place, low enough for spring ice to go over it. It moved downstream considerably and had to be brought back to place after the spring ice run subsided. Until the winter of 1858 no more crib work for dams was sunk through the ice.

Dam No. 5 was completed and after great difficulty from leakage masonry was begun Oct. 10th, and left 2 ft. 2 in. above summer water level by Nov. 24th.

At Pier 3 bed of river was 10 ft. higher on one side than on the other. Water was not pumped out of the cofferdam until Oct. 20th. Two nights later the engine house was burnt down and pumps etc. destroyed. The dam was then planked over and made secure until next year.

In 1856 the first operation was to sink mooring cribs from the ice for Piers 7, 8, 9, and 10. For Piers 8, 9 and 10 the cribs were in pairs, 20 ft. apart, 100 ft. upstream, arranged for dropping a timber apron hinged on a beam laid across downstream ends of the cribs by which the current could be sufficiently stopped so that cribwork for dams could be constructed in the eddy.

The cofferdam for Pier 3 was pumped out by June 2, masonry begun 9th July and completed 31st October.

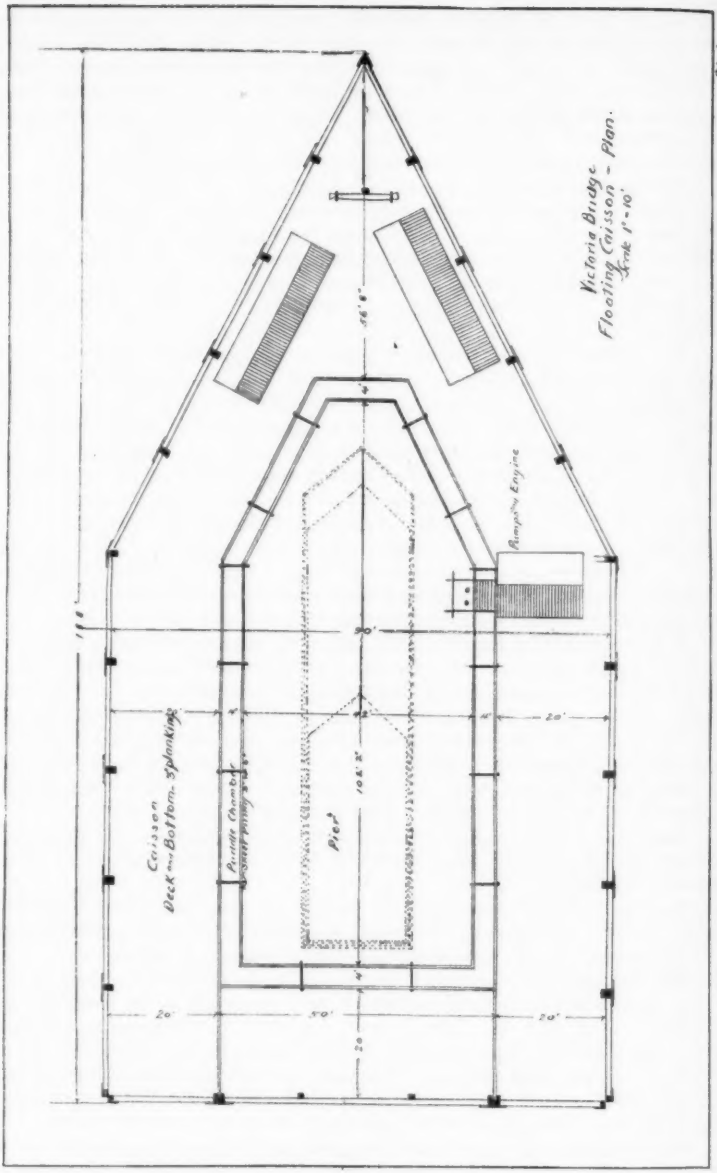
Victoria Bridge
Floating Caisson - Plan.
Scale 1"=10'
Pl. I.
Pumping Engine
Caisson
Deck and Bottom - Sheathing
Outside Coamings
Inside planking
Pier
104'-8"
56'-6"
110'
20'
50'-0"
20'
20'

FIG. VI.

With No. 4 Pier the main difficulty was getting material to it over the shallow water filled with boulders. A temporary bridge, supported by 2 scows, leading from Pier 3, solved the difficulty.

For Piers 5 and 6 the cofferdams were also formed of cribwork.

For Pier 7 the floating cofferdam was again brought into service. On June 3 it was in place and scuttled, on Aug. 12th pumping began and by Oct. 31st masonry was completed, after which the cofferdam caisson was floated and taken 5 miles down the river to winter quarters, about end of November.

Dams for Piers 23 and 24, framed of cribwork, were put in this year with little trouble. Material was carried to these piers by a tramway resting on cribwork piers. Hoisting and setting of stone was done by a steam derrick.

For piers generally, throughout the bridge, the stone was deliverel by barges. Work was simultaneous at a number of places. There was occasional difficulty in keeping the proper sized stone for the various working places supplied, thus causing delay, sometimes for days. Stone was in large blocks with outer stone of 10 to 15 tons. Six months was the maximum working season for laying stone.

In 1857 the solid ice formed the first week in January and the river broke up April 12th. There was delay in the early part of the season by reason of lack of funds, and it was end of June before work could proceed. The floating cofferdam was used for Pier 18. It was moved to the mooring crib June 18th and scuttled June 26th. By August 18th it was pumped out and excavation was begun. This had to be carried 9 ft. down to rock bottom. Masonry was completed November 26th. For Piers 19, 20, 21 and 22 dams were of cribwork and stone was taken out from the south shore by a tramway on cribs, same as before. All of these piers were completed this season.

Piers 8 and 9, cribs for which had been displaced the previous season by spring ice shoving, were proceeded with this year.

Shortness of season for setting masonry induced adoption of a method used successfully at St. Ann's bridge. Strips of asphalted felt, 3 inches wide, were used for bedding the stone courses and along outer edges, just back of pointing space. Open vertical spaces about 1 ft. square were left throughout the whole height of the masonry all this being carried on in winter. With return of regular working season pointing was done and the whole interior well grouted through the flues left Clear water filtering through the grouting accurately showed progress of filling voids.

Erection of the superstructure, fabricated at the Canada Works, Birkenhead, England, began this year. The staging consisted of Howe trusses supported on scows, 60 x 20 ft., sunk and kept in place by spuds, same as the floating cofferdams. The lower chords of the Howe trusses carried a platform of 3 inch planking resting on cross timbers; the upper chords carried rails on which the erecting traveller moved. The platform was 3 ft. 3 in. below position of underside of the tube. The bottom plates were first laid and held with bolts, the holes were then reamed and

rivetted. Drift pins were first used for nonfiting holes, but this was finally prohibited.

The bottom plates were laid to camber adjusted by oak wedges on longitudinal timbers. Erection of sides of the tubes began at centre of span with T bars for joints, the plates not quite to touch, otherwise the side was liable to buckle. The top plating followed the sides as closely as possible.

The tubes were united in pairs, fixed on the mid piers and having expansion rollers at the other ends. In the early part of the work the first tube of a pair was erected and swung and then the second one erected and joined to the first before supporting wedges of the former were taken out. This caused undue tension at the top and partial compression at the bottom when the second tube was swung. Later practice was to free both tubes and allow them to take bearing for ten days before they were joined. They were then connected at daybreak when temperature would be uniform throughout.

Staging construction was heavy and solid to prevent any subsidence during erection. Staging for span 25, at south shore was erected this summer, two Howe trusses with crib work support at the centre; and left for erection of tube during the winter. This was duly accomplished, erection beginning January 13th, and being completed March 31st.

1858. Cribs for five dams, 12 to 16 inclusive, were placed through the ice during the winter. A severe ice shove in the spring, before rise of the water, destroyed 14, 15 and 16 and, partly, 12 and 13. Most of the crib work had to be removed from the pier sites.

At Pier 17 the floating cofferdam was again used, with, however, a crib across the downstream end instead of the movable part. Excavation proceeded in usual manner by sinking a sump hole to or into the rock.

There was difficulty in getting stone out fast enough when work on six or seven piers was going on at the same time.

The north end piers were on bare rock to which sheet piling could be fitted. Further out, with deposit and boulders, the puddle chamber had to be wider and sheet piling heavier. Boulders and loose stone were, in general, removed by divers. At Piers 14, 15 and 16 a steam dredge was used to remove deposit, to rockbed. No. 10 dam was begun June 28th, completed 24th September and the masonry completed November 30th. No. 8 dam, abandoned in 1857 on account of leakage, was finished with much trouble and the pier completed October 21st. The embankment approach, south shore, was begun this year and carried to winter water level. At close of the season only No. 11 Pier remained to be founded, Nos. 14 and 15 to be carried up from summer water level and the abutment walls to be finished. During this season eleven spans, including No. 25, were erected. All erection of tubes was fairly simple and of same procedure as for span 1.

Camber for span 1 was set at three inches, this left slight sag after span was swung. The next span was set at six inches, a camber which left rise of two inches at the centre when swung. Fnally four and one-half inches was adopted for setting camber.

The crib supporting had always to be made strong enough to resist striking by timber rafts, many of which came down the river and were more or less unmanageable. For spans over shallow water the staging was in four lengths so that strong longitudinal timbers could be used instead of two trusses, and cranes used instead of travellers for moving the material for the tubes.

Detail erection plan of each tube was made at the shop, the Canada Works, and each piece carefully marked with its erection number or mark. There were nearly 5000 pieces for each tube. Arrived in Canada the pieces were stacked in order of erection.

As soon as it was evident that piers 12 and 13, for the centre span, would be reached by end of summer, two crib work piers were begun to serve as supports for continuous Howe truss erection staging, the ends of the truss to rest on corbels left for them on the piers. There was much trouble in placing these support cribs, due to the swift current, accelerated by blocking of the channel under the other spans.

1859. The ice solidified first week in January, and following days were the coldest for many years. For raising of material for the centre span a timber incline was built from the ice to the top of Pier 12, and a tramway laid on the incline, with trucks, to which the material was transferred by crane from the sleighs. The trucks were drawn up by a chain operated from an engine placed on the ice in front of Pier 12. For fire protection force pumps and hose could also be operated by the engine. This apparatus was under care of a watchman day and night.

Placing of the tube bottom, centre span, began January 31st. By February 9th, it was so well advanced that forty groups of reamers could be put to work, closely followed by the rivetters. Work was continued at night by light from large fires in braziers. The men worked with thick gloves and heavy overcoats; they had to stop when temperature dropped to 20 below zero. Many men were taken to hospital for frost bites. On February 12th the first pair of side plates was erected. Side plates were machine rivetted at the shop in lengths of three plates, about ten feet, and so brought to the bridge on sleighs.

Camber of the larger centre span was adjusted to 6 inches. There was partial subsidence, owing to settling of staging. Finally the camber was reduced to 4½ inches and when the span was swung there was a sag of 3 inches, but otherwise the tube was well in line.

Bottom of the tube was completed February 28th, with 180 feet of sides up. By March 11th the greater part of the iron was in place and on March 21st all iron was in place, notwithstanding a severe storm on the 15th which destroyed much of the scaffolding. On March 26th rivetting was practically completed and the span swung.

The centre tube consisted of 10309 pieces and required nearly half a million rivet holes. Fabrication at the shop in England was so accurate that all rivet holes fitted in erection, requiring only some reaming.

Much difficulty, both in building the piers and in erecting the superstructure, was caused by the numerous timber rafts coming down the river. These rafts were in general about 40 ft. by 250 ft. in size. They

were difficult to guide through the comparatively narrow openings between the staging supports, or even between the piers at full span, with the swift current. At one time during erection 35 rafts were seen from the bridge.

Work on cofferdam for Pier 11, which was begun May 3, was completely wrecked by two rafts striking it. It was again proceeded with and was slow and difficult work. By August 12, with excavation work under way, the first foundation stone for this the last pier could be laid, as was done in presence of 300 spectators. The pier was completed in six weeks, with 108,000 cubic feet of masonry.

During erection of No. 12 span one cribwork support of the staging was struck by a heavy scow, used in removal of No. 11 pier cofferdam. The crib moved downstream 2 ft. and the tube, partly completed, dropped from the supporting wedges to the timbers, but remained on these. At one time thirteen rafts, shifted by a sudden squall, struck piers and staging supports, causing a jam of loose timber which was finally cleared away. During course of erection of superstructure several spans were in danger of falling on account of rafts striking the staging supports. On the 17th of December, the day appointed for first passage of trains the last staging was carried away by ice and thus the river cleared of all obstruction except the piers.

Roofing of the tubes was of wood, covered with tin, with a two foot wide footway on the centre ridge. Rails over the webs of the tubes carried an iron traveller, projecting over the sides, for painting. The permanent track through the bridge was laid with 63 lb. U rails resting on 12x14 inch continuous timbers, with oak ties spaced 14 ft. The timbers were bolted to place at the rest piers; at all other places they were notched over the floor beams, to allow for expansion. The rails were fastened down with dogs, with rolled iron chairs of 14 lb. weight at the joints. Holes cut in the webs and spaced 60 ft. admitted light to the tubes. A 4 ft. footway extended along one side of the track.

During all the work on Victoria Bridge a medical staff of five doctors was maintained at a cost of over £1000 annually.

The spans were tubular girders, built of iron plates, in general plan similar to the Menai Straits bridge, and were continuous in pairs. The tubes were 16 ft. wide, 18 ft. 6 inch high at the ends increasing to 22 ft. height at the centre. Of the 25 spans 24 were 242 to 247 ft. in length—it was apparently easier to slightly vary the tube length than to exactly locate the piers—and the centre span 330 ft. Under clearance was 36 ft. at the abutments with grade from each end toward the centre of 1 ft. in 130, about 2 ft. to the span, giving clearance of 60 ft. under the centre span.

The 24 piers were of solid masonry, with stone 5 to 20 tons in weight held together by iron clamps. 22 piers were 90x18 ft. at water level, 33x16 ft. at top. The centre span piers were 28 ft. wide at water level 24 ft. at top. The abutments were 240x90 ft. Approach embankments were rip-rapped with 5 to 8 ft. of stone to resist ice shoving.

Maximum increase in camber of the tubes observed in one day was 1¼ in. with temperature 124° on top and 90° at bottom. Maximum

observed expansion in one tube from temperature range of 27° to 128° was 3¾ in., maximum lateral movement 1¼ inch.

The bridge was designed to carry a live load of 1 ton per running foot throughout. Dead weight per regular span was 252 tons made up as follows:

| | |
|---|---|
| Top of tube | 76 tons |
| Bottom tube | 92 " |
| 2 Webs | 84 " |
| Total | 252 " |

or approximately 1 ton per running foot, making total of live and dead 2 tons per running foot.

Unit stresses were taken at 4 tons per square inch in compression and 5 tons in net tension.

As to tubular girders, which were extensively used for a considerable period, the general rule became established that the minimum depth should be one-fifteenth of the span length. In the Victoria Bridge the ratio was one-twelfth.

The Report by Alexander M. Ross, Chief Engineer, George E. Bruce and B. P. Stockman Assistant Engineers, states that erection of the last tube, span 14, was completed Monday December 12th, 1859. One week later the bridge was opened for traffic.

In testing, a live load of 1 ton per running foot, as near as this could be attained with a train, was imposed over the full length of two spans at a time. With load on one tube only, the deflection was ⅞ in. with a slight lift of centre of adjoining span forming the continuous pair. With load covering the two spans of the pair deflection in each was ¾ inch. The ton is 2,240 lbs. throughout.

The centre span, when loaded full length, showed deflection of 1⅜ inch. All tubes returned to original form with test load removed. The actual deflection was well within what had been computed. The tubes had excess strength over designed loads and stresses. The centre span test gave only ⅝ of the computed deflection.

It was found difficult to make up a train of what was considered the enormous load of 1 ton per running foot; a load which would surely never be attained by ordinary traffic!

The engineers recommended acceptance of the bridge, and expressed regret that Mr. Robert Stephenson, according to whose wishes everything had been carried out, did not live to see completion of the structure.

## REBUILDING THE VICTORIA BRIDGE.

In 1897-98 the single track tubular bridge was replaced by a double track, pin connected, truss bridge superstructure, 24 spans of 254 ft. uniform length having parallel chords and 40 ft. depth between centres of top and bottom chord pins, with 31′2″ width centre to centre of trusses throughout the bridge. The larger centre span is of correspondingly greater heighth. 17 ft. roadways are carried on brackets on either side of the trusses.

The old piers were lengthened, but only above the water table of the cutwaters, for the greater width of the new spans. Below the water table the piers remain unchanged, the foundations being ample for the new loads.

The new railway live load capacity is two 294,000 lb. consolidated engines followed by a trainload of 4,000 lbs., for each track.

The masonry work was done by Wm. Gibson of Beamsville, Ontario, and the superstructure by the Detroit Bridge & Iron Works, 10 spans; the Dominion Bridge Co. 6 spans; and the Union Bridge Co. of New York, 9 spans. The whole work was carried out under direction of Joseph Hobson, Chief Engineer G.T.R. as Chief Engineer. Trains began to run on the double track of the renewed bridge December 13th, 1898.

## THE INTERNATIONAL BRIDGE.

This bridge crosses the Niagara River a short distance below Lake Erie, from Black Rock, Buffalo, to Bridgeburg, Ontario, with an island intervening.

The project for the International Bridge had its origin in 1857 when charters for it were granted by the Parliament of Canada and by the Legislature of the State of New York. Lack of funds kept these charters dormant for thirteen years.

The Buffalo and Lake Huron Railway was the first Canadian Railway interested in the project.

Capital was at length subscribed in England in 1870, £272,500, and the Grand Trunk Railway Company was authorized to guarantee annual interest to the extent of £20,000, upon which the "International Bridge Company" with a nominal capital of $1,500,000 was formed.

The contract for building the bridge was let to C. S. Gzowski and D. L. McPherson of Toronto for $1,000,000.

Stone piers and iron superstructure were required, with two swing-bridges, one over the river channel and one over the Erie Canal at Black Rock, both being pivoted on centre piers, with main channel span 362 ft. total length, having two openings of 160 ft. each, and the canal span two openings of 90 ft. each.

Chief Engineer of the bridge was E. P. Hannaford, Chief Engineer of the Grand Trunk Railway, and Resident Engineer Joseph Hobson, Chief Engineer of the Great Western Railway.

The bridge site entailed great difficulties of construction, such as depth of water of nearly 50 ft. maximum with frequent and sudden fluctuations due to winds piling up or holding back the water of the lake, treacherous bottom, a current varying from 5½ to nearly 12 miles an hour, exposure to large timber rafts throughout the season of navigation, and impossibility of working in the stream during winter season on account of floating ice.

| | | | |
|---|---|---|---|
| Length: | Abutment Canada side to abutment Squaw Island | 1,967.5 | ft. |
| | Across Squaw Island | 1,167 | " |
| | Squaw Island to E. Shore | 517 | " |
| | Total shore to shore | 3,651.5 | " |

From the west abutment there are 6 piers to east end of the channel swingbridge. The first three spans are 197 ft. each, the next three 248 ft. each. The pivot pier is No. 7 and east end of draw No. 8. Span, draw to Squaw Island, 197 ft.

Normal depth of water: at Pier 1, 10 ft.
" 2, 20 "
" 3, 33 "
" 4, 47 "
" 5, 48 "
" 6, 30 "
" 7, 16 "
" 8, 9 "

The superstructure was built by the Phoenix Bridge Company, the general design Whipple, double intersection, trusses with Phoenix columns and connections. Canadian Railways using the bridge were the Grand Trunk Railway, the Great Western Railway with special connection from Glencoe, and the Canada Southern Railway.

The total cost including extra cost due to difficulty of foundations, connections, 3½ miles, with New York Central, and with Canadian Railways, also interest during construction, was a little under $1,500,000.

Characteristics of river. A northeast wind will lower the water 2 ft. in half a day; while a southwest gale up the lake will raise the water 4 to 5 ft. in as many hours and increase the current to 12 miles an hour. The riverbed is rock along the west shore, approaching Squaw Island it is partly clay with overlying gravel.

The river never freezes across. There are heavy ice runs at the beginning of winter until ice sets in the lake, and again on breakup in spring. Occasionally during winter large fields break loose. Ice on the lake forms up to 3 ft. in thickness.

Altogether the difficulties of the site: great and fluctuating depth of water, velocity of current and its rapid change, ice floes and ice runs, timber rafts, etc., and lack of appliances and methods developed later, constituted the building of this bridge, especially as to its foundations, one of the most difficult undertakings in the history of bridge building.

Construction began early in 1870, from the west or Canada shore. Pier 1 is next to the Canada shore. Piers 1, 2 and 3 were built during the first season, pier 3 being finished December 23.

For Piers 1, 2, 3, 4 and 5 water-tight caissons of heavy timber, 12x12 inches and heavier, were built ashore and floated to place. The bottoms were of six solid layers, longitudinal and transverse. These caissons were first loaded with concrete to depth of practicable draft then towed to a short distance above location, anchored, the river bottom cleared of boulders by divers if required, then the caissons let downstream to position, this being given by guide marks and instruments from shore, and sunk to place.

The west abutment was begun in January 1871 and finished in April.

With Pier 4 caisson, in the deeper water and swifter current, the first greater difficulty was encountered. The caisson broke loose, one of its anchor cables parting just as it touched bottom, and grounded

about 60 ft. below the bridge line. This was in May 1871. A new method, carried out the two following years, was adopted for piers 4, 5 and 6. This was to build a massive bottomless enclosing caisson, sink it to place and then within it sink the caisson for the pier. Very powerful tugs, and heavy anchors and cables were required to move and hold these unwieldy outer caissons. Located on river bottom with much difficulty they had then to be dredged out and material removed from under their cutting edges to sink them to rock bottom, after which the pier caissons were floated in.

Pier 5 caisson met with worse disaster than caisson 4, also in 1871, being struck broadside by a timber raft, over 300 ft. long by 80 ft. wide, which had become unmanageable. Crashing timber and caisson dragging its anchors were all carried downstream about 200 ft. to the lower end of Squaw Island.

The caissons in general were rectangular at the stern and pointed at the bow with length, varying slightly for the different piers, of about 48 ft. stern to shoulder and 55 ft. over all, and width about 17 ft. Sides and ends were vertical. The upper part was bolted to the lower which in final position was below water level, the upper part being later detached. Barges at the sides, larger than the caissons and held together by chains beyond the ends of the caisson, steadied the latter, otherwise unstable and topheavy, and allowed sinking of the caisson clear of the barges.

Most of the foundation work in Black Rock Harbor, spans 9 and 10, was done in 1871. Here, with the great depth of clay bottom, as likewise for piers 6, 7 and 8, piling was used. Piles were spaced 3 ft. centres and cut off at ground surface. The watertight caisson was then brought to rest on the piles. Abutments 3 and 4 and pier 10 the pivot pier for the harbor draw span were completed in 1871. Pier 9 was begun in Nov. 1871 and finished in March 1872.

In 1872 abutment 2 and piers 7, 6 and 5 were built.

Caisson for pier 4 was finally placed in July 1873 and the pier finished in October.

Pier 6. Enclosing caisson not carried to bed rock as it encountered hard clay which could not be dredged out. Therefore piles driven throughout within the caisson, and cut off close to bottom. Then stone rammed in to pile tops, and on this watertight caisson placed.

The icebreakers, the upstream toes of the piers, were covered with half inch boiler iron, and had slope of 6 inches horizontal to 12 inches vertical, steep as compared with the Victoria Bridge piers, to prevent ice from passing upward too high. Sides and ends of all piers, except upstream, had batter of 1 in 24, with rack face except for ice breakers and surface of copings, which were bush hammered. The pivot piers are octagonal and not of solid stone throughout, but filled with concrete in the quarters.

The stone for the underwater part of the masonry, a hard, compact, very heavy blue limestone, was from the village of Bertie about 7 miles from the bridge. Most of the stone above water came from Georgetown and Acton, on main line of the Grand Trunk Railway, west of Toronto

FIG. IX. VICTORIA BRIDGE—ERECTION OF CENTRE SPAN.

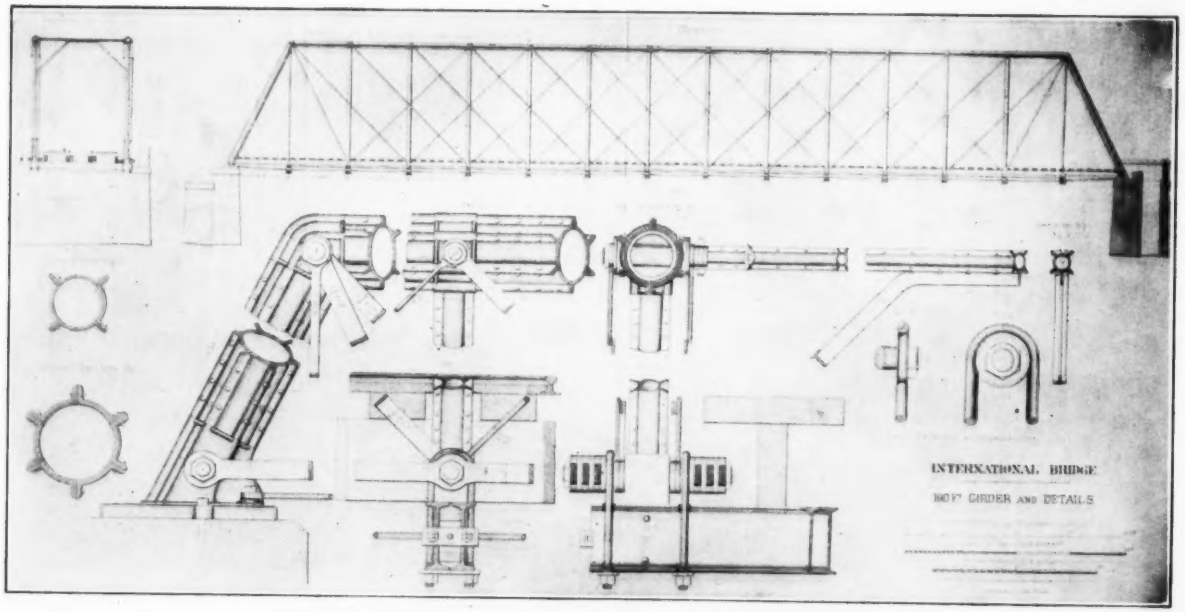


FIG. X. DETAILS OF PHOENIX COLUMNS, INTERNATIONAL BRIDGE.

and some from Berea, Ohio. It is a close grained solid free stone, light in color. The courses are 12 to 24 inches thick.

Clamps and dowels were used in the ice breakers of all piers, as also at the quoins at the downstream ends of the piers.

The concrete was mixed, all by hand, in the proportion of 1 cu. yd. broken stone, passing through 2½ in. ring, 1¾ bbls. of cement and the same quantity of sand. All masonry work was done from scows.

Superstructure and erection. The spans were double intersection Whipple trusses with Phoenix columns and cast joint blocks and pedestals. Intermediate posts were of four rolled segements, end posts and top chords of six segments. In the majority of previous bridges cast iron had been used for top chords. Tension members were eyebars and the trusses pin connected throughout. Transverse bracing, top and bottom, was of round, adjustable rods, connected by means of stirrups and yokes. For stringers there were two 8 in by 18 in. timbers under each rail, with outer stringers 5 in. by 18 in. Ties were 6 in. by 12 in. spaced 1 ft. clear, guard rails 6 in. by 6 in. oak, 8 in. outside of each rail. Floor beams were two 15 in. I beams suspended from bottom chord pins by yoke hangers next to posts.

Height of trusses was 26 ft. throughout except for the main draw span which was 36 ft. at centre. Trusses were spaced 20 ft. centres.

Spans 1, 7, 8, 9, and 10 were erected on fixed falsework. Spans 2, 3, 4, 5, and 6 were erected on floating staging resting on pontoons. There were five pontoons for the 197 ft. spans, and six for the 258 ft. spans. The pontoons were 17 ft. wide x 55 ft. long, pointed at the bow. Each pontoon had one long cable and these were gathered together 500 ft. upstream to one camel pontoon which was held by three heavy anchors, one directly 500 ft. further upstream and two spreading. To move this great mass of pontoons loaded with the erection falsework against the swift current required a number of powerful tugs. The pontoons were of course transversely held in place by the stiff and continuous falsework resting on them and extending to the piers.

The staging was in two heights or stories, the lower to directly under floor beam positions, the upper resting on but not attached to the lower, to near top chord levels. On top was a low traveller for the placing of truss members. The lower staging was floated entire, from span to span, the upper was taken down and re-erected. The top staging was light and was carried by the truss when lower part was out.

Spans 1, 2 and 3 were erected in 1871, being finished in October; early in 1872 the Black Rock Harbor spans were erected, the draw span and span 10. The river draw span was also erected this year and swung in January 1873. The remaining spans were erected in 1873.

The bridge was designed to carry an engine load of 2,000 lbs. per running foot of track with following train load of 1,300 lbs. per running foot. Wrought iron specifications were: Ultimate strength 55,000 to 60,000 lbs. squ. in., elastic limit 25,000 to 30,000, reduction of area at fracture 25%, elongation 15%. Unit stresses: Compression in top chords and end posts 8800, interior posts 5000; tension, bottom chords, 10,000, web members 7500; shear in pins 8000.

The first locomotive crossed the Black Rock Harbor spans July 24th, 1873, and October 27th, 1873, the first locomotive passed the full length of the bridge.

The bridge was formally opened for traffic November 3rd, 1873, by Richard Potter, President Grand Trunk Railway Company and C. J. Brydges, President International Bridge Co.

## REBUILDING.

With greatly increased weight of live load it became necessary to replace the superstructure of the International bridge. This was done in 1901 by the Detroit Bridge and Iron Works, with single track steel trusses throughout, of nearly double the capacity of the former ones. The cost of this replacement was approximately $300,000.

Later the United States Government required an increased width of channel in Black Rock Harbor, the Erie Canal entrance. This necessitated reconstruction of the canal part of the bridge. A new double track swing span, 432 ft. in length on a new pivot pier and new abutments was erected in 1910-11, replacing this part of the bridge, which had been renewed in 1901. The new live load was two engines, each of 390,500 lbs. including tender, followed by 5500 lbs. per foot of track (Cooper E.55). The cost of this 1910-11 rebuilding was $405,000.

During the year 1915, the New York State legislature required provision on the bridge for the passage of vehicles and pedestrians from the mainland to Squaw Island. The outcome after some contention was that in 1921 a highway floor was constructed on one side of the draw span and a passageway for pedestrians on the other side. This addition, including the approaches, cost $34,088.

## ST. CLAIR TUNNEL.

The St. Clair Tunnel Company was incorporated in Canada in 1884 by officers of the Grand Trunk Railway with Joseph Hickson, General Manager of the Grand Trunk, as President. Joseph Hobson, Chief Engineer of the Great Western division of the Grand Trunk, was appointed Chief Engineer. Two years before an examination of the site had been made by Walter Shanly, for the Grand Trunk. He reported a crossing three miles below the G. T. R. ferry at Pt. Edward, as the most favorable location for the tunnel. On further investigation Mr. Hobson adopted this as the location. In 1885 borings were made, 50 ft. downstream from the adopted location line, to determine the nature of the material, and results were not considered favorable. The material to be penetrated was found very similar to that which had caused abandonment of the project to build a tunnel at Detroit in the early seventies. The river bed is fine sand and gravel, under which is a soft but tenacious stratum of clay to a shaly bed rock. It was decided to first carry out small drift tunnels from each side to ascertain practicability of the full sized tunnel. A small shaft was sunk on each bank. On the Michigan side the drift tunnel advanced only about 20 ft. while on the Canadian side it was

pushed out 186 ft., both drifts being carried forward without the aid of compressed air. Difficult material and gas were encountered and it was decided to go no further. In 1888 borings were made to the clay stratum directly on the line of the tunnel. The clay stratum had previously been found to vary in thickness to a minimum of 38 ft.

The plan finally adopted was to bore the tunnel through this clay stratum about midway between the underlying rock and the river bottom; and to do it by means of a tunnel shield working in compressed air, to hold up the soft clay.

Length of the tunnel proper is 6,026 ft., total length with approaches 11,553 ft., from surface to surface. Diameter of bore is 21 ft., interior diameter 20 ft. Grade of approaches is 2%; under main part of river the tunnel is almost level, having a grade of one-tenth of one percent toward the Canadian side, for drainage. The tunnel shell consists of cast iron flanged segments 2 inches thick. The lower half is lined with brick and cement to a total thickness of 6 in. Longitudinal timbers and ties carry the track which is of 100 lb. rail.

The shields, penetrating from the portals on each side of the river, were 15'3" long with outer diameter of tunnel bore. They were designed by Chief Engineer Hobson on general lines used before, but with many new and special features. They were propelled by 24 hydraulic rams of 18 in. stroke.

As contractors were afraid of the risk and no satisfactory tenders could be had the work was carried out directly by the company, by day labor.

There was delay, due to earth slides in the approach excavations and to other causes so that the tunnel work proper did not get well under way until about midsummer of 1890, after which progress was rapid, the shields moving as much as 9 ft. a day each. The tunnel was opened for traffic in September 1891.

The cost was $1,460,000 which was materially below preliminary estimates.

For some years the tunnel was operated by ordinary steam locomotives. Difficulty of proper ventilation, vitiated air by reason of sulphur fumes from the coal and danger of trains stalling in it induced change to electric traction.

## THE COTEAU BRIDGE.

The Canada Atlantic Railway at first used a ferry for transfer of its traffic across the St. Lawrence River between Valleyfield on the south shore and Coteau Landing, opposite. This ferry became inadequate for the company's constantly increasing business. In the fall of 1888 the contract for the substructure of a bridge at this point was let to Messrs. Neelon, McMahon & Shea of St. Catharines, Ontario. During the following winter quarries were opened, stone cut, barges built and the necessary plant put in readiness. Ground was broken for the north shore abutment on April 1st, 1889 and all the foundations were completed by December 6th of the same year.

The contract for the superstructure was let to the Dominion Bridge Co. early in 1889. Erection began September first of that year and the last span was floated to position on the 19th of February 1890; the bridge was put in service for traffic the following morning. The entire time of construction from the beginning of the foundation to the time of turning the bridge over for service was ten months and twenty days.

Increasing live loads, as in other railway bridges, necessitated the renewal of the superstructure of the Coteau Bridge and this was done in 1911, the new bridge being designed for Cooper E. 50 loading. At the same time the substructure was reinforced throughout.

## Illustrations.

Fig. I. First train with engine, Champlain & St. Lawrence Ry. 1837. From a print in the Chateau de Ramezay, Montreal.

Figs. II and III. Early wood burning engines, Northern Ry. and Grand Trunk Railway.

Fig. IV. Photograph showing double gauge, Great Western Ry. Windsor, 1865.

Fig. V. Map, Grand Trunk Railway System, 1902.

Fig. VI. Drawing, Floating Cofferdam, Victoria Bridge, Pl. I.

Fig. VII. Drawing, Details of puddle chamber, Victoria Bridge, Fig. 1, Pl. II.

Fig. VIII. Drawing, U Rail. Victoria Bridge, Fig. 2, Pl. II.

Fig. IX. Erection of centre span. Victoria Bridge.

Fig. X. Details of Phoenix Columns, Etc. International Bridge.

## Sources.

Grand Trunk Railway. Directors Reports 1854 to 1919.

Special period maps and tabulated general data on Canadian Railways.

The Railways of Canada, J. M. & Edw. Trout, 1871.

Life and Times of Sir Alexander Tilloch Galt, Skelton.

Canadian Annual Reviews, J. Castell Hopkins.

Government and other Reports, and pamphlets. Etc.

Construction of the great Victoria Bridge in Canada, James Hodges, Engineer for contractors.

The International Bridge, C. S. Gzowski.

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EDITOR'S NOTE: It was the original intention that one of our members should contribute an article on the history and development of the Grand Trunk Motive power. Unforeseen difficulties and delays have prevented to make this article appear in this bulletin. Our members however, will have it to look forward to in one of the bulletins that will be issued next year and it is to be hoped that the material substituted will be of equal interest.